Proceedings from a series of regional seminars on microelectronics in the wood products industry.*

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in co-operation with

Maritime Lumber Bureau

New Brunswick Forest Products Association

and

Nova Scotia Forest Products Association

presents

"Improving Productivity Through Microelectronics

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Contents

Foreword 3
Opening Address 4
Industry Overview: The Need to Update Canada's
Wood Product Manufacturing Facilities 5
Productivity in the Manufacturing Sector:
How Does Canada Stack Up? 7
Coping With Microelectronics:
The Labour Viewpoint 11
A Canadian Sawmiller's Impression of
European Sawmill Technology 13
Room for Improvement in Canadian Sawmills 15
The Need to Update Canada's Wood Product
Manufacturing Facilities 16
Room for Improvement 23
Improving Yield at the Headrig
Through Computerization 31
Computerized Sorting Systems 36
The Mechanical/Electrical Interface 43
The Use of Microprocessors for
Sawmill Management Information 50
The Industrial and Regional Development Program 56
Panel Discussion 59
Closing Remarks 63

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Foreword

The following proceedings relate to a seminar entitled Improving Productivity Through Microelectronics presented on November 23, 1983. The seminar was the third of four regional seminars, on the same theme, which were presented at various locations in eastern Canada. The preceeding seminars were held in Ottawa and Timmins and one followed in Quebec City.

Financial support for the seminar was from the Federal Department of Regional Industrial Expansion.

Forintek Canada Corp. wishes to acknowledge the federal government contribution and the role of the Maritime Lumber Bureau, New Brunswick Forest Products Association and Nova Scotia Forest Products Association as co-hosts of the seminar.

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Opening Address

R.W. Stephens
Forintek Canada Corp., Ottawa

I would like to welcome everyone to this seminar and express my appreciation for such an excellent turnout, not only in these troubled times, but also in a month when we are never quite sure what the weather is going to do to us.

We are here to talk about improving productivity through microelectronics. Actually, today is the fourth in a series of eight regional seminars which are sponsored by the federal Department of Regional Industrial Expansion. These seminars are part of an exciting new federal initiative called the Industrial Regional Development Program, or IRDP. You will be hearing more about these acronyms and programs throughout the day. As some of you may know, Forintek has been retained by the federal government to present these seminars. We are doing so in our capacity as Canada's national wood products research institute in conjunction with industry associations. Our presence today is a direct result of the tremendous support and co-operation we have received from our friends in the Maritime Lumber Bureau, New Brunswick Forest Products Association and the Nova Scotia Forest Products Association.

The link with such associations is extremely important and is a very clear directive in the mandate that we received from the federal government when we were asked to organize these seminars. We have had tremendous support from association executives and staff across the country and this is due to the fact that association people spend countless hours helping their members keep pace with changes in the industry. Associations often provide specific training and information sessions for their members. This type of program presents a good opportunity for them to maintain this practice.

The seminars have three basic objectives and I think it is important to spell them out so that we all know what they are about. The first is to promote awareness of the links between technology and productivity. The second is to provide practical information for you, focussing on coping with technological change. We also hope to facilitate the concensus building the information exchange process between business and labor decision-makers.

Forintek, of course, is unable to tackle that challenge alone, so we assemble groups of expert speakers to help us address and define those particular objectives.

Just a word about the benefits of these seminars as we see them. The benefits to industry are dependent on the individual companies attending this session and the experience of that company and its present level of technology. We will all adjust to the type of data that we want to relate to. We have all heard that other peoples' experiences with microelectronic applications have resulted in many benefits. Productivity, for example, has apparently been improved.

We also hear that the use of microelectronics allows people to remain, or become and remain competitive in world markets. I think that is something of particular interest to our friends in this part of the world because of the present pressure in this country to be more efficient. That pressure is evident also in other countries where the resource is even scarcer than it is here. This pressure is producing innovative technical developments and improved human skills that we must wake up to. The basic reason that these countries are efficient is because they have to be. To compete against them we must be just as efficient and just as technologically advanced. As in all aspects of the free enterprise system, the market will decide who succeeds and who fails.

In these seminars we hope to address the real 'blood and guts' issues. The objective is not to dazzle you with gobbledegook or weird terminology. We will try to explain words that may not be familiar. This morning we will try to define the problems and opportunities in general ways and this afternoon direct ourselves to some very specific technical subjects. The range of topics will be discussed by speakers who are knowledgeable about the equipment details and how they work. We will also have people telling you about their own experiences with applications, setting up of systems, how they handled the problems and the very important subject of the impact of this technology on the labor force. That aspect is, I think, a secret concern of everyone here today.

* * *

Industry Overview: The Need to Update Canada's Wood Product Manufacturing Facilities

A.G. Rumbold
Maritime Lumber Bureau

To establish and legitimize a need to update our manufacturing facilities, one must look at two areas. Where do we stand today in these Maritime Provinces and what is the demand?

The Interim Report of the Forest Industries Advisory Committee of 1983 indicates that world demand for forest products will increase by two to three per cent per year in the next 20 years. Three per cent in the pulp and paper sector and one per cent in solid wood products. This increase is less than during the past 20 years but still represents a 50 per cent increase by the turn of the century.

Residential housing in both the United States and Canada will decline substantially during the 1990's. This is because of demographic reasons and the Baby Boom will be over. However, we can safely assume that these declines will be offset by increases in industrial uses (packaging, panelling, pallets, etc.) and the rapidly growing home renovation market in North America. This is also similar in the two other traditional Canadian export markets. Japan, which will continue to grow and Europe which projects the growth to be at around one per cent annually.

As we export some 70 per cent of our lumber we are extremely reliant on international trade. We must remain competitive if we are to meet trade threats from the U.S.A. This threat is twofold, increasing supply from the south and the southwestern areas where the major economic growth in the U.S. will take place. Secondly, the great emphasis the U.S. is placing on exports. These exports will be to the traditional areas we are presently servicing Europe, Japan and the Middle East. Further, we must take into consideration a substantial increase in supply of the Radiata pine from New Zealand, South Africa and Chile.

At an educated guess, Canada's production will increase to 21 billion fbm by 1990 (it is probably going to be 19 billion this year) and an American production which will be at 40 billion fbm in 1993 (or up from some 26 million fbm in 1983).

How are we going to fare here at home? From time to time we get the feeling that because we plant millions of seedlings annually, all is well. We should understand however, that every tree we harvest during the next forty years is growing out there somewhere today now!! In fact we have until about the year 2000 for an oversupply of spruce and fir, much of it overmature, unhealthy and of a tumbled down appearance. We have more over-ripe wood than we can possibly use each year. If we can keep the forest alive by good protection from fire and budworm this is what we are going to have to use. The harvest will be dictated by the budworm and management which will not necessarily direct the ideal log to our mills. We will have smaller, crookeder, rottener logs to work with in some cases. Often logs will be harvested because they are there and will be of excellent quality. In any case, we will have to be versatile.

As I have outlined, we will be facing increased competition at world level in all our markets. We have to face this with poorer raw material and by increasing efficiency and productivity wherever we look.

Why? We have to compete with companies who annually sell from one desk as much as we produce here in the Maritimes. Therefore, we must compete not only with the Americans, the Swedes and the New Zealanders but also our own Canadian industry. We must become more efficient and more productive. Our mills will have to change to accommodate an ever changing and probably deteriorating raw material.

The need will be for high output from robust and exact machinery with few moving parts and programmed where possible. Strict quantity and

quality control must be maintained throughout the sawing process. Sawing practices will have to change. We will no longer be able to break down the log in the traditional way and hope to sell the total product. Sawn for best recovery or most dollars are decisions which must be made on opening the log. They cannot always be made mentally in the instant of time available. The mill will no longer be able to accumulate a variety of sizes hoping that a buyer will eventually come along. The value of the log must be optimized by modern electronic methods.

To bring us up to 1983's situation. The market was high during the summer but fell back to last year's levels during the fall. Both the United States and Canada will reach record levels of production. At the same time the North American demand was healthy, the recovery was well underway, interest rates were moderating and house building 60 per cent better than in 1982. Still we had a dropping back of prices. This was caused partly by losing some of our market share in Japan and Europe. As our dollar increased in value our exports remained the same and did not increase with our production. Quite simply, demand is not keeping up with supply. This situation will continue as the industry becomes more efficient and productive. We need new markets or new products and cost competitiveness.

Cost competitiveness will be the key to future survival in world wood products markets. Although world demand is projected to increase by 50 per cent by 2004, there will be an abundance of world forest biomass, particuarly from countries that Canada trades and competes with. Canada will no longer be the dominant force in a scarce resource, but simply a major participant in an increasingly competitive environment.

Being cost competitive means addressing productivity aspects of labor and capital inputs, conversion efficiency, labor costs, and raw material costs, i.e. total production costs. There are strong indications that Canadian production costs vis a vis the rest of the world will be high for the following reasons:

- Delivered wood costs will increase faster in real terms because we are still relying on an increasingly inaccessible and lower quality old growth resource.

- Recent wage rate settlements and our poor labor/management relations mean higher unit labor costs.

- The level of technology in Canada may well be lower because our competitors are spending more on R&D.

- Our competitors are investing considerable effort in intensive forest management (plantation forestry), while we are still talking about the 'possibility' of running out of natural timber.

Canada must put relatively more emphasis on productivity gains to carry us through the transition from relying on natural timber to relying on second growth stands. We must find ways to compensate for higher relative production costs in the interim period. This means a concerted effort by government, industry and labor to work together. Increased productivity is the key both in the forest and in the mills.

If we do not remain cost competitive, we will lose market share and this will be translated into lost jobs and income for Canadians. In addition, cost competitiveness is necessary to maintain an attractive investment climate which has a direct impact on capital spending, and thus on productivity.

We will have to meet this competition by making sure that our segment remains competitive and upgrading research and development to ensure the optimum use of our raw material. We must have greater efficiency and recovery in the mills and higher levels of 'value added'.

* * *

Productivity in the Manufacturing Sector: How Does Canada Stack Up?

J.E. Lewis
University of New Brunswick

The forest products industry accounts for: one job in ten in Canada; one job in seven in New Brunswick; $1 billion to New Brunswick; 40 per cent of New Brunswick manufacturing output; and 38 per cent of New Brunswick exports. Many perceive the industry to be New Brunswick's major strength, but because of its vulnerability, it could be our major weakness.

Two major difficulties exist: rising competition from abroad and rapid changes in technology.

The Competition

The Amazon rain forest of two and a half million square miles and is now being invaded by road builders, farmers and wood producers. Slash and burn techniques are used to clearcut the forest at the rate of 50,000 acres a day. Modern techniques are entering this region, techniques introduced in New Brunswick 30 years ago.

To stay ahead of the competition, more rapid modernization is necessary, modernization brought about through what many have described as the third industrial revolution. This has been brought about by the marriage of two techniques:

- The microchip
- Increased capacity for communication

This can be broken down by considering:

- The nature of advancing technology
- The impact of advancing technology
- Current state of high-tech in Canada
- High-tech successes abroad
- Directions for education, government and industry
- Recommendations

The Nature of Advancing Technology

Recent advances in technology have led many to believe that western society is on the verge of a third industrial revolution. This is due to rapid developments in fabricating large scale electronic circuits on tiny silicon wafers (microchips), and to a lesser extent by the vastly increased capacity of electronic communication through Telidon, word processing, direct broadcast satellite, pay TV and interactive two-way cable connections.

The impact of the microchip on the consumer will be enormous and all-pervasive. The history of one's entire family can be stored on a single chip, including medical records, accounting, taxes, births, deaths, marriages, etc. The microchip can control one's home, operate lights, read power and water meters, control heating, warn of intruders, cook dinner, wash dishes and do the laundry. Communications will be considerably extended through direct advertising, telephone directory service, answering telephones, transferring calls, finding a babysitter, calling for police, fire or ambulance, pay bills, providing information on elections and taking opinion polls. Within five years there will be more of these microprocessor-controlled devices in the average home than there are rotating machines, i.e. more than fifty. It has been predicted that by the end of the century there will be more microprocessors on earth than people.

The functions which can be performed by the microchip in industry are limited only by imagination. Robots will assemble automobiles, TV sets, test stereos, set newspaper type and control all manner of industries. The office workplace will be

revolutionized primarly by large information storage systems, with data immediately available to managers with no intermediate handling of paper by clerks.

The Impact of Advancing Technology

Much has been written on the impact of this new technology on society with predictions ranging from the extreme of vast unemployment and industrial upheaval to utopian society with a reduced workweek, job-sharing, more leisure time and the removal of man from boring repetitive tasks. Only the passage of time will attest to the truth of individual predictions. However there are some predictions that can be made with some certainty:

- Many jobs will be lost, particularly in secretarial, clerical and assembly line operations. The auto industry has substantial evidence of the latter, today employing half the workers of three years ago.

- Many of the jobs lost in the recent recession in the industrial heartland of Canada were not lost temporarily but are lost forever. The protection of non-competitive industries by governments, although maintaining jobs may be very short-sighted.

- The skilled worker of the future will not be the person who produces one high-quality aircraft part each day, but rather will be the individual who produces, tests and maintains electronics, robots and information systems.

- The unskilled worker of the future will not be a laborer, but rather a button pusher, with the capability of replacing those who may currently be regarded as 'skilled' workers.

Current State of High-Technology in Canada

There are a number of indicators of the growing importance of technology to Canada. The sale of computers in Canada is equal to that of the auto industry. Small firms even in the Maritimes produce world class navigation electronics and electronic materials.

There are a number of successes which are worth noting:

- Bell Northern Research (BNR) and Northern Telecom are multi-national world class leaders in telecommunications technology.

- Mitel is rapidly approaching the class of BNR in digital communications technology.

- In spite of poor publicity and hard times, the CANDU reactor is the world's best and safest.

- Canada is world leader in domestic satellite technology, most notably the Anik series. Export sales of this technology are being negotiated with several countries.

- The success of Spar Aerospace, especially the CANADARM is an excellent example of leadership in certain aspects of space technology.

- Telidon is widely accepted as one of the best available home and business interactive communications systems.

Before becoming complacent over these successes we should also examine our dismal failures:

- We do not manufacture an automobile that will compete in any international market.

- We do not competitively manufacture our own TV's, stereos or consumer electronics.

- We are one of the world's major suppliers of raw gallium arsenide which we sell for a few dollars a pound to Japan where a single company turns them into pure crystals, sold to the U.S. for $20 each where four manufacturers turn them into transistors which are sold for $100 where ten manufacturers turn them into direct broadcast satellite low noise amplifiers which we buy for $1200.

- We do not manufacture our own computers yet.

- Canada does not apply technology to its resource utilization, but instead only to its production.

- Canada does not yet produce sufficient numbers of highly trained individuals for current high-technology industries. In spite of our one and a half million unemployed, 20,000 skilled workers and professionals were recruited abroad in 1982.

- Canada has only two major microchip manufacturers, BNR and Mitel.

High-Technology Successes Abroad — What Can We Learn?

Case 1: "There is more gold in the sewers of Palo Alto (30 ppm) than was produced in the California gold rush."

Much has been written of the enormous successes of the Silicon Valley in California, North Carolina and Massachusetts. Similar high technology complexes are developing rapidly in Washington, Baltimore and Minneapolis. The growth of the computer, microelectronics and information industries in these

regions is now thankfully being emulated in the Ottawa area. These complexes were spawned by close cooperation with previously established research and development activities of universities. Professor Terman of Stanford University encouraged his students Hewlett and Packard to establish their own business, the first of silicon valley's high-tech industries.

Most, but not all, Canadian provinces are, as a matter of provincial government policy, committed to developing high technology industries close to those major universities where expertise and research capability exist to assist in the transfer of technology to these industries.

A partial list of the products of California's Silicon Valley includes: bipolar read only memories, flip flop gate arrays, shift registers, analogue to digital converters, magnetic strip card readers, Schottky rectifiers, micropattern generators, cartridge disc drives laser printers, modems, multi-tasking processors, daisy wheel printers, multiplexers, emulators, floppy discs, add on memories, add in memories, bubble memories, encryption sets, chip testers.

Almost none of these products is developed and manufactured in Canada.

Case 2: "...The most startling application of this concerted drive to transform France into a technologically advanced country that can rival the United States and Japan is taking place amid the poor fishing villages and farms of Brittany."

The province of Brittany in France was the most economically depressed in the country. Its farmers and fisherman left behind the mainstream of French society by seasonal unemployment, poor farmland and an uncertain fishery. Even that was devastated by a major oil spill which destroyed fish stocks and wiped out tourism. Two key decisions were made by the French government. One was to place the equivalent of Telidon terminals in every house which had a telephone; and the second was to locate the industry in a concentrated area of Brittany. Today seventy thousand people work in France's high-technology industry in Brittany and three thousand engineers are on waiting lists to move into the area.

This scenario could be repeated in New Brunswick if a concerted effort were made to encourage such industry here and if the industry were located close to New Brunswick's research centres a U de M and UNB.

The Microcomputer Revolution: Canada's Redemption or Ruin?

The microcomputer will have a greater influence on civilization than the automobile. However, unless Canada rejects the role of just being a user and takes an active part in their manufacture, the microcomputer will be the worst thing that ever happened to Canada.

There can be little doubt that if New Brunswick simply imports this technology, and does not become involved in the innovative development and manufacturing of silicon products then we must continue to rely on our primary resource based industries. As stated, the Amazon rain forest covers two and a half million square miles and is being clear cut for agriculture and forestry at the rate of 50,000 acres a day, with the growth rate of trees five times that in New Brunswick. Without high-technology industries we might wonder about our standard of living in the next century.

Directions For Our Education System: Improving Our Technical Literacy

In recent Science Council of Canada conferences on science education in the country some consensus was reached on science education in New Brunswick. The most urgent need is the necessity to upgrade science teachers in the province. Th teachers were the first to recognize this need. In surveys conducted by the Science Council, the majority of science teachers admitted to preferring not to have to teach science and to not having taken a university level science course. Yet the majority are also willing to be upgraded. Currently almost no teachers are in the universities training to be science teachers at the secondary school level.

Curriculum revision was also recognized as an urgent need. Most school science programs in Canada are the product of the Sputnik scare of the 60's and were developed by pure scientists, rather than technologists. Yet the majority of employment opportunities are in technology rather that pure science. Changes are needed to place more emphasis on technology rather than pure science.

It is possible today for a young person to graduate from high school with almost no exposure to science at the secondary school level, yet that individual can vote for a government which could advocate closing Lepreau, cessation of budworm spraying or banning microwave communications. Yet this new young voter may not understand the nature and effects of ionizing radiation, that more harmful radiation can be obtained from exposure to the sun than inside Lepreau's containment building or what species of wildlife in New Brunswick are affected by budworm spraying.

The argument is best made by Suzuki:

"The result of this widespread scientific illiteracy is that rarely, if ever, are candidates for elective office asked for their positions on such issues as the intrusion of computers into our private lives, the revolution in communications technology, the future of the CANDU reactor, public exposure to potent herbicides and pesticides, occupational disease, alternate energy, euthanasia, recombinant dna, sociobiology, marine management of our 200-mile off-shore waters, oil spill hazards in the high Arctic, the future of scientific research in Canada and the myriad of pollutants: arsenic, mercury, PCB, PVC, dioxin, asbestos, radon and acid rain. Yet those elected will make decisions on these items and many more with long-term consequences that future generations will live with long after the politicians are gone.

"A recent survey of MPs in Ottawa revealed that most of them come from two professions law and business. Yet when the MPs were tested for comprehension of elementary terms and principles of science and technology, businessmen and lawyers scored the lowest.

"We badly need an overhaul of our educational system to ensconce science as a core subject along with the three R's."

And also from the Science Council of Canada:

"Students wishing to pursue technological careers are principally concerned with applied science, but the latest reforms of science education in the early 1960's emphasized the pure sciences. Such an approach is inappropriate not only for these students but also for the majority...

"If Canada is to maintain its economic and social vitality in the 21st century, we cannot afford scientifically or technologically illiterate citizens.

"What is now urgently required is curricular reform that will develop science programs with a strong orientation toward application, technology, and social implications. It is imperative to demonstrate that science and technology are critical to Canada and that appropriate science and technology are strongly and characteristically Canadian in nature."

Summary and Recommendations

There is a great deal the Government of New Brunswick can do, surprisingly some of which does not even cost money but only require changes in policy. I will present a summarized list of recommendations:

- To reject any notion of simply becoming adoptees of the new technologies.
- To encourage the development of high technology industries close to the existing research and development facilities of its two major universities.
- To upgrade the science teachers in New Brunswick.
- To undertake revision of science curricula towards technology and its impact on society, particularly at the secondary school level.
- To require more core science and technology courses of all high school graduates.
- To continue its laudable effort in supporting high technology training and technology transfer in the universities and community colleges, particularly in the fields of robotics, microelectronics, information systems and computer technology.
- To accerate the process of making existing industries more productive and efficient through introduction of new technology.

* * *

Coping With Microelectronics: The Labor Viewpoint

John McEwen
New Brunswick Federation of Labor

I work in the pulp and paper industry where I have seen first hand the effects of automation and technological changes on my fellow workers as well as on the community as a whole.

As a union leader I have tried, along with my colleagues, to convince employers and governments alike of the ramifications caused by what could be termed as 'progress'. We have not succeeded, however, but I still believe there is hope since the price of failure would be such a tragedy.

I would like to say at the outset that labor does not oppose progress. We believe that we are truly on the threshold of a new industrial revolution in this country, which will even have a greater impact on society than the first industrial revolution, and it will take our unified efforts to adjust to the changing times.

We believe that our society can benefit from progress, but to do so we will have to alleviate its effects on all of us and it will take the cooperation of all.

In June 1983, the federal Minister of Labour spoke to the plenary session of the International Labor Organization in Geneva, using as a topic his concern for some of the effects of modernization and the need for consultation between government, labor and business on the aspect of the growth of technology, and its impact on employment.

I would like to quote his concluding remarks: "The challenge precipitated by the computer and robot is with us. The stakes are high. The contrast between hope and despair for our future is great. We cannot afford complacency. We alone will be held responsible for the shape of our future."

The words 'microprocessor', or 'micro chips' may bring to mind a number of pleasant and useful developments: wallet-size calculators, high precision stereo equipment and advancements in the performance ratio and fuel efficiency of cars. On-the-job technological change can mean an enhancement of working life especially through the elimination of hazardous work. Properly guided, technological change can be a boon to the Canadian economy. However, for this to occur, a number of significant changes are needed in attitudes, legislation and in other areas.

The issues surrounding technological change are not new.

Whether it is health and safety problems involving VDT's or layoffs caused by a temporary downturn in the economy, we are faced with the untrammeled right of management to make decisions, irrespective of the needs of its employees or of Canadians as a whole, on the introduction of changes in equipment and methods of work which affect the entire bargaining relationship.

Job loss, retraining needs, new health and safety concerns, all these effects can be the result of technological change and should be discussed with the unions before they are implemented.

From an employer's point of view, high technology promises great economic gains and most of the interest in the new technology has been from the engineering side and from economics. I would like to remind you however that the workers' attitudes towards technological change or the introduction of robots in the workplace are complex and pessimistic and may create resistance that could reduce and undercut the economic benefits.

We must remember that work done through a computer is more abstract than other forms of work because the worker's actual contact with the task being performed is less direct. And as work becomes

more abstract, many employees may feel that they have lost their sense of judgement about their task. People may become frustrated by the loss of control over their job.

It is quite possible that as people become more technical and sophisticated, they will have an inferior understanding about the lumber business. Many workers may also feel threatened by the new technology and may believe that management want to increase its powers of surveillance and control over them. Workers then may react to this change by taking fewer risks and exercising less initiative.

On the other hand, displaced and laid off workers due to new technology will add to an already stressful situation in most small New Brunswick communities where unemployment is at record levels.

It will be important to overcome this feeling of insecurity that is prevalent among workers. I can by no means offer the complete solution to that problem, though it is felt that much could be accomplished in alleviating some of the fears. But in the workplace and in the community the first step would be for the employers and the unions to agree on an intent clause which, even if it does not foresee problems associated with technological changes, can at least give both parties a basis for discussion.

Employees should be kept ahead of technological changes by their employers providing continual training on the job or, in some cases, offering leaves of absence for some to continue studies even if it means sponsoring them by paying a portion of fees or setting up educational funds administered by both parties.

Employers should also develop the capacities to get the greatest input from their employees who are specialists in their craft and may have good ideas for improvements or even to be very keen to be part of technological changes.

The facility of good communications is only successful if applied on an ongoing basis and it should be all-encompassing, or at least include as much information as possible without alerting competitiors to points of confidentiality.

It is important for workers to receive early notice of the employer's intention to introduce technological changes. Negotiations will prove unsatisfactory if all the decisions on equipment and job design have been made by management and all relevant orders placed before the union is notified. For too long, the image of the boss of the company to the workers has been the enemy: That has to be turned around to create the environment whereby an employee is proud of the company he or she works for.

In this new evolution, if that is what it can be called, there is a need for a change in managing before you can manage for change. We also have to ask what role the government can play.

The government will have to legislate on all issues related to technological changes, such as prior notice, health and safety, ongoing training, relocation of workers and paid education leave. To be more precise, labor supports wholeheartedly the concept for paid education leave whereby a worker could complete his education or even start a new carreer through such a program.

You must remember that the sawmill industry revolves around small communities in every part of New Brunswick and that all these communities are already affected by a high unemployment rate brought about by a declining economy. Any further erosion of the employment situation in these communities will have a profound impact on our society as a whole. In that context, the role of government is very important.

Finally, I firmly believe that productivity will develop very rapidly once an honest and sincere effort is made to treat all workers with the justice and dignity they deserve as human beings.

* * *

A Canadian Sawmiller's Impression of European Sawmill Technology

A.F. Smith
Ashley Colter (1961) Ltd.

The following outline constitutes my impression of the sawmill technology used in Norway and Austria. This information was received from a sawmill study tour organized by Mr. Tony Rumbold, executive director of the Maritime Lumber Bureau in the spring of 1981. The 17-day tour included 16 sawmills of 10,000 to 300,000 cubic meters capacity (three to 10 million fbm). The size of the mills was comparable to the operations that the eight sawmillers and their wives on this tour represented here in Eastern Canada.

We visited two logging operations and I found it very rewarding to look at the results of over 200 years of good forest silviculture where only the desirable species, namely Norway spruce, pine and larch are kept. This was accomplished through three to four thinnings in the life of the stand.

The forests of these countries are approximatey 80 per cent owned by private individuals (in New Brunswick it is almost the reverse as pproximately 70 per cent is owned by the Crown). Therefore, the sawmills rely heavily on farmers and private woodlot owners for their log supply.

The trees grow much taller than our species, therefore there is a very small amount of taper. The logs are cut with very little rot and some operations were cutting to a minimum of eight inches top diameter. Logs were selling at over $400 per meter at roadside.

The 16 sawmills we visited were equipped with different types of equipment, i.e. twin saw, circular saw headrigs, band saw headrigs, carriage, gang saws, slab chipper headrig and other equipment.

Most debarkers were of the ring type, debarking dry. This operation was separate from the sawmill. It consisted of scaling, debarking and sorting to log diameters and was accomplished by one man. The logs were placed on a deck where they passed through a scanner which recorded the log dimensions and cubic meters on a printout sheet. From this record the contractors were being paid. Comparing eastern Canada, this would be a two or three man operation with extra equipment to re-handle the logs. The log then passes through the debarker, then through another scanner which programmed the log so it dropped off in a bin to the proper diameter class. Logs were then stored in a paved yard or on skids free of the bark so worms would not infest them. This sorting allowed the sawmill to pre-set the mill equipment for maximum recovery as only one diameter was fed to the mill at a time.

The headsaw and breakdown equipment was not unlike that found in eastern Canada, with the exception of the circular saws which were solid tooth, taking out approximately one half the kerf size that our inserted tooth circular saws would take. Regardless of the type of equipment used in the breakdown of the log, it would be programmed or pre-set for maximum recovery of the diameter class being fed into the mill.

Edgers were of various makes and models, with many of them electronically set. Trimsaws were quite rare and if there was a unit in use it was a pop-up type to cut off long sliver ends before edging.

Lumber left the sawmill untrimmed, was sorted automatically or manually on the green chain to the separate dimensions with all lengths in the same bundle, then stickered ready for the yard or dry kilns. Most mills had dry kilns and large sheds so very little of the lumber was exposed to the sun.

After the lumber was air dried or kiln dried it went into the finishing mill for dressing, double end trimming, grading, sorting to grade and packaging to desired lengths. A computer tally and specifications were placed on each package. The end was usually

trimmed every ten centimeters (3.9 inches). This eliminated a lot of waste, compared to our mills trimming every 12 inches.

Sawlogs were of much higher quality than those found in eastern Canadian mills (particularly in New Brunswick where we have scaling regulations stating the following as 'no defect': crook, splits, seams, hard rot, cat face or square faced logs).

Sawmills and finishing mills are much more automated than ours with double the production per man; have much better recovery from the logs, 60 to 68 per cent comparing to our maximum 50 per cent, again because of better logs, smaller kerf, pre-sorting for diameter classes, shorter trimming lengths, etc.

Lumber was better looked after upon leaving the sawmill with the planer mills being stored under sheds. Most log and lumber yards were paved so peeled logs could be stored without picking up dirt. The sawdust and bark waste was quite often used to generate electricity or steam for heating the mills and dry kiln. Two of the mills were also heating houses in the adjoining villages.

I was very impressed to see such large investments put into sawmills, with so much dependence for saw logs from the private sector.

* * *

Room for Improvement in Canadian Sawmills

R.W. Stephens
Forintek Canada Corp.

In his opening remarks, R.W. Stephens explored the need to update Canada's wood product manufacturing facilities. The content of his introduction was based upon the following paper, authored by Forintek's economist, Dr. A.T. Schuler, and the main part of his presentation was derived from a paper entitled "Room for Improvement: a discussion of machine centre inefficiencies based upon sawmill improvement studies performed by Forintek", authored by W.F. Love of Forintek's Lumber Manufacturing Technology Department.

In the interests of providing the reader with complete information, we are publishing both papers in full.

* * *

The Need to Update Canada's Wood Product Manufacturing Facilities

A.T. Schuler
Forintek Canada Corp.

There have been recent concerns by government and industry that the Canadian wood products industry must increase productivity if it is to remain competitive in world markets. Maintaining competitiveness is extremely important for Canadian producers due to our heavy reliance on international trade. For example, Canada exports 70 per cent of its softwood lumber production accounting for approximately 45 per cent of all international trade in softwood lumber. In addition, Canada supplies approximately 27 per cent of the world's market pulp and 37 per cent of the newsprint used in the non-communist world. We also ship half of our waferboard to the United States.

We have investigated these concerns and have attempted to provide some insight on why productivity is now a major concern in a country, that historically has been the dominant force in a scarce resource. This report will emphasize solid wood products; however, due to the complimentary associations with the pulp and paper sector, the latter industry will receive some treatment.

Supply / Demand Considerations

Demand

Recent studies (1, 2) indicate that world demand for forest products will increase by two to three per cent per year in the next 20 years—three per cent in the pulp and paper sector and one per cent in solid wood products. Although this is considerably less than increases in the previous 20 years, it still represents a 50 per cent increase by the turn of the century.

Looking more closely at solid wood products, the softwood lumber demand picture is not as promising. World demand is expected to grow by a modest nine per cent by 1990 over 1979 levels—less than one per cent per year. Residential housing, the largest single user of softwood products, is expected to decline substantially during the 1990's, largely due to demographics in North America. Canadian housing starts are projected to decline to the 150,000/year level and U.S. starts will decline to an average level of 1.4 million/year during the early 1990's. However, most observers feel that these declines will be fully offset by increases in industrial uses (packaging, panelling, pallets, etc.) and the rapidly growing home renovation market in North America.

Looking more closely at the U.S. housing market, major declines will occur in the north east and north central states as Americans relocate in the south and southwestern regions in response to migratory trends and economic problems such as those facing the auto and steel industries. Canadian mills will face increasing competition from U.S. suppliers in servicing the southern growth area.

On the brighter side, Japanese imports of Canadian lumber are expected to increase from 1.1 billion BF to 1.8 billion by 1990; however, there will be increasing competition from the United States and other suppliers. European demand for Canadian lumber is expected to remain relatively stable in the next decade with the U.K. remaining the major market.

Regarding the softwood plywood industry, most projections show demand to increase in U.K., Western Europe, Scandinavia, and Japan. However, Canada will again face increasing competition in Europe and Japan from U.S. suppliers.

Physical Supply

Softwood sawlog supply is projected to increase by five per cent (non-communist world) by 1990 - less than one per cent per year. Major new sources will be Latin America, Oceania, Africa, the Middle East and S.E. Asia. Softwood lumber production will remain relatively stable in the next decade. Canada will increase production to 21 billion board feet by 1990,

an average annual increase of 1.4 per cent. U.S. lumber production is expected to return to 1979 levels (40 billion BF) and increase slightly by 1993. Lumber supply from Europe and Scandinavia will increase little, if at all.

There will be major increases in softwood lumber supply from New Zealand, Chile, and South Africa by late 1990's. These increases will occur as major plantation timber matures.

Economic Supply

Although physical supply is projected to match total demand (as it must), it is the delivered cost of timber that will have a major impact on allocating market share of the world demand. Canada has enjoyed historical economic advantage over international competition due to an abundance of natural timber. However, future world supply and demand will be more closely in balance and this means that suppliers with lower delivered wood costs will have a competitive advantage.

Canada's forest sector is entering a critical period of transition. The old growth stands are becoming less accessible and recovery costs are escalating. Similarly, existing natural stands have lower density and quality of timber, hence the value of timber harvested per land area is declining. Eventually, Canada will have to shift from an old growth timber-based economy to a managed second growth economy. However, this will take years because Canada has been very lax in her forest renewal program.

Canadian production costs are projected to increase at a two to three per cent annual real rate while costs are expected to remain relatively stable in Europe and to rise only slightly in the U.S. Higher harvesting costs, lower wood quality and diminishing supplies in Canada vis-a-vis the rest of the world are major contributing factors.

Canada will also face increasing competition at world market levels due to product substitution (composites for conventional lumber and panel products); intermediate and end-use product differentiation and shifts in the domestic forest policies of our major trading partners. The U.S.A., Scandinavia and Western Europe have relatively active forest renewal programs in place and, according to a recent report from the U.S. Office of Technology and Assessment, the U.S. may soon be in a position to be a major force in international wood product markets. Other factors include the proliferation of tariff and non-tariff barriers to trade.

Recent Productivity Trends

Cost competitiveness will be a prerequisite for economic survival in world wood product markets in the future. Canada will have to put relatively more emphasis on productivity in converting trees into wood products, simply because our production costs will be higher than most of our competitors and there will be tougher competition in all of our traditional markets around the world. We will have to find ways to compensate for higher relative wood costs, at least until our second growth forests are economically mature.

Labor Productivity

Recent labor productivity trends in Canada indicate that two sectors—saw and planing mills and veneer and plywood mills—are now more productive than the all manufacturing average (Fig. 1). This has been due largely to the introduction of labor saving technology in these industries.

Examples of ongoing developments are computer-controlled log handling and sorting systems; electronic scanners and computer system control of sawing, peeling, clipping, and drying operations; automation of finished lumber sorting and semi-automatic assembly lines in plywood.

These developments are, by the way, a complete reversal of the pre-1970 era when the forest products sector traditionally lagged behind the aggregate of non-agricultural industries in terms of productivity increases (3). For example, during the period 1961-69, labor productivity increased 3.9 per cent per year in manufacturing industries whereas only three per cent and 1.4 per cent increases were registered in the sawmilling and pulp and paper industries respectively.

A major difference between the U.S. and Canadian forest industry is that the American pulp and paper industry has made the most significant increases in labor productivity in the past decade (Fig. 2). In fact, the American pulp and paper industry is now the lowest cost producer in the world for major grades of market pulp. The veneer and plywood industry has also made significant gains, but there have been no such gains in the saw and planing mills.

Although labor productivity has been increasing in parts of the Canadian solid wood products industry, real unit labor costs have also been increasing (Fig. 3), particularly in the saw and planing mill sector. This means essentially that labor costs have been increasing faster than productivity increments. Conversely, unit labor costs in Canadian veneer and plywood mills have not increased as much in real terms over the past decade.

A look at similar developments in the U.S. indicates that unit labor costs for sawmills and planing mills have increased less than their Canadian counterparts

and unit costs in veneer and plywood mills have actually dropped by 20 per cent since 1965.

Comparing labor productivity on a world-wide basis, we see that Canada leads the world in physical labor productivity for the aggregate solid wood products industry (Fig. 4). We have twice the productivity of Norway and the U.S., and 1-1/2 times that of Sweden and Finland in terms of M^3/man-hour.

However, when we look at changes in productivity over time as measured by indices, we see that the Scandinavians are making great strides in improving productivity (Fig. 5), particularly during the period 1975-1980. Productivity increments in both Canada and the U.S. aggregate solid wood products industry have flattened out during the period 1977-1980.

Other Productivity Measures

Labor productivity is only one component of cost competitiveness. Capital productivity as measured by output per current value of capital assets is an integral component, yet it is very difficult to measure. Capital productivity represents a measure of the current level of conversion technology. Therefore, we can use conversion factors as a proxy for capital productivity. Conversion factors represent input of wood raw material required to produce a given level of finished wood product.

In the conversion efficiency category (Table 1), we see that Canada is the least efficient producer (world-wide) of hardwood lumber products. In addition, we are among the least efficient producers of softwood lumber and plywood products. The relatively high figure in the sawn softwoods column for the U.S. is misleading because production was based on actual dimensions whereas all others are based on nominal dimensions. The comparable U.S. figure is in the 1.85 - 1.95 range. Conversely, Canadian mills producing particleboard and fiberboard (waferboard) are the most efficient in the world.

These conversion figures are an indication that Canada is now having difficulty in converting smaller and lower quality raw materials into lumber and plywood products. In addition, many of our western mills are old and not geared to the available resources. On the other hand, the Canadian composite product facilities are relatively new and represent the latest technology available.

Future Concerns

Although physical labor productivity has been one of the bright spots for the Canadian forest products industry, there are other factors involved in determining cost competitiveness in world markets. Conversion efficiency, raw material costs and wage rates are all part of the picture. We have already discussed future problems with raw material costs, but there are other interesting developments that will impact on Canada's ability to compete in world markets.

We already mentioned that conversion efficiency leaves much to be desired in the softwood and hardwood lumber sector and in the plywood sector. There are indications that Canada will fall further behind, technology-wise, if research and development expenditures are any indication of future levels of technology. As seen in Fig. 6, we have historically spent less on R & D than our major competitors. The U.S. spends four times as much as Canada, Sweden three times as much, and Norway and Finland spend relatively more than we do.

Canada has some very serious labor/management problems. Historically, Italy has had the worst strike record in the western world; however, if we look at recent trends for 1980-82, Canada is now in the unenviable position of having the worst strike record (Table 2).

Looking more closely at individual sectors, we see that forestry is the third highest in days lost per union member (Table 3). Coupled with this poor strike record are recent trends in wage settlements that have Canadian forest sector wage rates increasing faster than their American counterparts.

Our major competitors are investing considerable effort in intensive forest management. There has been a significant increase in plantation forests in the United States, Scandinavia, Western Europe, Japan, South Africa, Australia, New Zealand and South America. The U.S. south, for example, is now working on their "Third Forest" while Canada is just beginning to initiate policies and programs to increase forest productivity. The major emphasis of recent programs has been on forest renewal; however, complementary programs in forest protection, supply of trained manpower, education and training facilities and research are needed.

Productivity is something that we are going to have to address to carry us over this interim period until we get to the point where we can start relying on the lower cost second growth forest. We are going to have to figure out ways of staying competitive during this interim period and productivity increases are the best way to achieve this. We are going to have to deal with higher relative production costs and this means that we are going to have to increase productivity. Microelectronics is one way that we can do this in order to increase our conversion efficiency and to extend the resource itself. In other words we have to increase utilization and also increase our total productivity — thus reducing unit costs.

So microelectronics has a major role to play and we are going to have to spend more time and effort on increasing productivity than the rest of the world if we want to try and hold onto our markets.

Conclusions

Cost competitiveness will be the key to future survival in world wood products markets. Although world demand is projected to increase by 50 per cent by 2004, there will an abundance of world forest biomass, particularly from countries that Canada trades and competes with. Canada will no longer be the dominant force in the scarce resource, but simply a major participant in an increasingly competitive environment.

Being cost competitive means addressing the productivity aspects of labor and capital inputs, conversion efficiency, labor costs, and raw material costs, i.e. total production costs. There are some strong indications that Canadian production costs vis-a-vis the rest of the world will be high for the following reasons.

- Delivered wood costs will increase faster in real terms because we are still relying on an increasingly inaccessible and lower quality old growth resource.
- Recent wage rate settlements and our poor labor / management relations mean higher unit labor costs.
- Technology levels in Canada may well be lower because our competitors are spending more on R & D.
- Our competitors are investing considerable effort in intensive forest management (plantation forestry), while we are still talking about the "possibility" of running out of natural timber.

Canada must put relatively more emphasis on productivity gains to carry us through the transition period of relying on natural timber to relying on second growth stands. We must find ways to compensate for higher relative production costs in the interim period. This means a concerted effort by government, industry and labor to work together. Increased productivity is the key — both in the forest and in the mills.

If we do not remain cost competitive, we will lose market share and this will be translated into lost jobs and income for Canadians. In addition, cost competitiveness is necessary to maintain an attractive investment climate which has a direct impact on capital spending, and thus on productivity.

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2. U.S. Office of Technology Assessment. 1983. Wood Use - U.S. Competitiveness and Technology. Congress of the U.S.A., Office of Technology Assessment, Washington, D.C.
3. Sandoe, M. and M. Wayman. 1977. Productivity of Capital and Labor in the Canadian Forest Products Industry, 1965 - 1972. Can. J. of For. Res. 7:85-93.

* * *

Table 1

Conversion Factors Relating Input of Raw Material to Output
(m^3 solid wood volume in the rough / m^3 production)

COUNTRY	END PRODUCT				
	Sawn Softwoods	Sawn Hardwoods	Particle-board	Plywood	Fibreboard
Finland	1.93	1.68	1.24	2.94	1.41
Norway	1.97	—	1.48	—	1.61
Sweden	2.00	1.84	1.48	2.54	1.74
Canada	2.05	2.26	0.96	2.71	0.79
U.S.	2.61*	2.09	1.45	2.22	0.80

* Production based on actual dimensions, all others are based on nominal dimension.
Source: F.A.O. Conversion Factors for Forest Products.

Table 2

Days Lost Per 1000 Employees (Yearly Average)

	1973 - 1982	1980 - 1982
Canada	914	834
Italy	1,211	752
Australia	705	730
Britain	471	374
United States	396	267
West Germany	40	9

Source: **The Financial Post**, August 27, 1983, p. 1.

Table 3

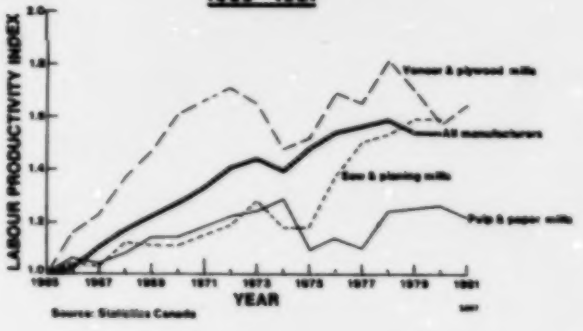
Days Lost Per Union Member by Industry, 1973 - 1982

	Days Lost Over Decade	Percent National Average
Fishing	138	475
Mining	118	421
Forestry	46	164
Finance	43	153
Construction	42	150
Manufacturing	40	143
Agriculture	33	118
Transportation	22	78
Trade	15	64
Service	12	42
Public Administration	9	32
All Industries	28	

Source: **The Financial Post**, August 27, 1973, p. 2.

Figure 1.

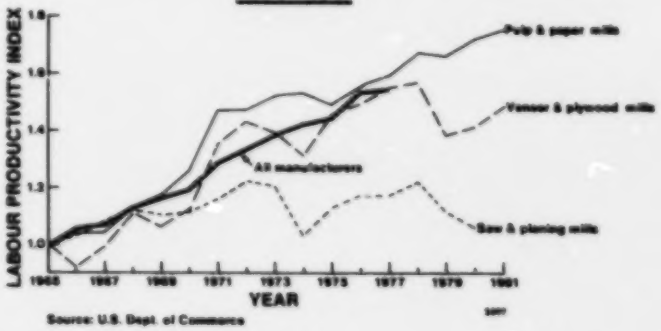
LABOUR PRODUCTIVITY IN THE CANADIAN FOREST INDUSTRIES
1965 - 1981



Source: Statistics Canada

Figure 2.

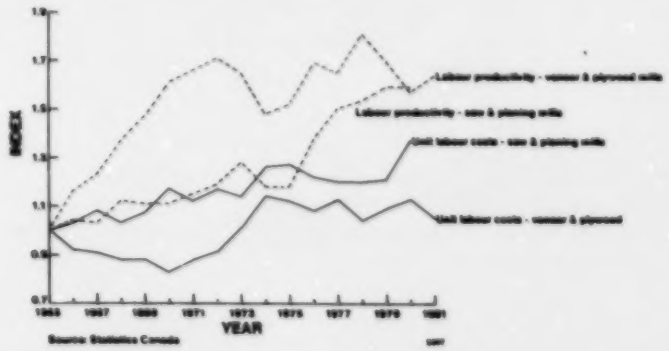
LABOUR PRODUCTIVITY IN THE U.S. FOREST INDUSTRIES
1965 - 1981



Source: U.S. Dept. of Commerce

Figure 3.

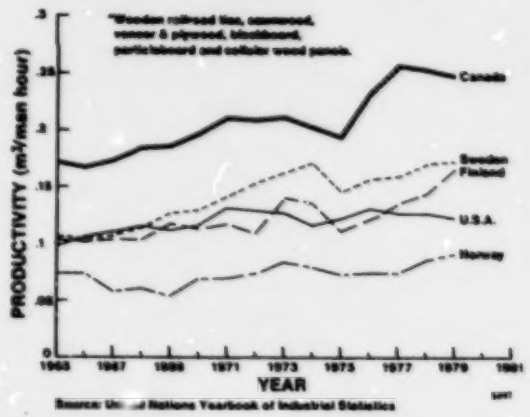
INDICES OF PRODUCTIVITY AND UNIT LABOUR COSTS - CANADA (costs in 1965 funds)



Source: Statistics Canada

Figure 4.

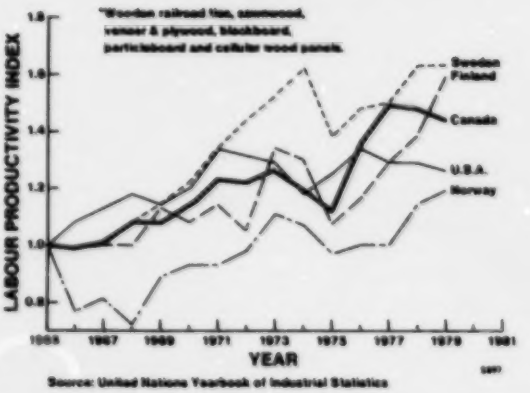
LABOUR PRODUCTIVITY IN SOLID WOOD PRODUCTS* (m³ per man hour)



Source: United Nations Yearbook of Industrial Statistics

Figure 5.

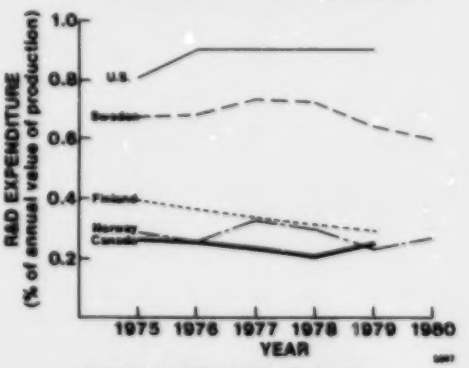
LABOUR PRODUCTIVITY INDICES IN SOLID WOOD PRODUCTS*



Source: United Nations Yearbook of Industrial Statistics

Figure 6.

RESEARCH AND DEVELOPMENT EXPENDITURES BY GOVERNMENT AND INDUSTRY IN WOOD BASED INDUSTRIES



Sources: U.S. National Science Foundation
U.N. Yearbook of Industrial Statistics
Dept. of Industry, Trade & Commerce, Canada

Room for Improvement

A discussion of machine centre inefficiencies based upon sawmill improvement studies performed by Forintek.

W.F. Love
Forintek Canada Corp.

We — and I am speaking now for the sawmilling group at Forintek — feel that profitability at each and every sawmill can be improved with little or no major capital investment. There are some very good mills out there, but there is always room for improvement. This paper sets out to identify those areas we have found in our work where improvement can be made in most mills. We, as a sawmilling group, have studied 62 individual log breakdown systems in 47 different sawmills under our Sawmill Improvement Program (SIP). At this point, I will outline some background on this program for those who may not have heard of it.

The SIP program was originally initiated by the Eastern Forest Products Laboratory of the Federal Government and was expanded in 1979 following the formation of Forintek. The objective of this program has been to identify areas where improvements could be made to an existing operation. As well, we try to estimate the benefits associated with these recommendations so that improvements with the greatest financial return are easily identified. In the past, many of these improvements would require additional manpower and capital.

Today, however, the diminishing cost of process control equipment and its adaptability make it a great tool for improving any existing operation. I would like to look at some examples from the work we have done to illustrate where there is room for improvement. These examples involve improvements in productivity or recovery because they are one and the same when you get to the bottom line.

We have identified five major areas where we feel there is usually room for improvement in an existing operation. We call this the Road to Improved Recovery and Productivity.

As you can see, the five areas are:

- Improving Log Quality
- Improve Log Allocation
- Optimize Log Breakdown
- Minimize Lumber Size
- Improve Productivity

All five have a significant effect on the overall profitability of the sawmill. Improvements can be made in each of these areas with little or no capital investment.

Improving Log Quality Entering Mill

Here we are talking about all the operations which affect the log before it is actually processed. These operations are important because any efforts here can't be corrected in the mill. Slashing has a tremendous impact on the final product yield. Poorly slashed logs invariably result in reduced recovery and productivity. The important points to consider in checking log quality coming into your mill are:

- sweep
- crook
- log length
- overlength
- debarking

The first two, sweep and crook, we all know are a problem in that they reduce recovery and productivity. Computer controlled bucking systems should reduce this problem in the future. The other three points are:

- log length
- overlength
- debarking

These are less obvious but shouldn't be overlooked as they affect profitability. How much? Well, let's have a look at an example considering the first two, log length and overlength. Just so we are talking about the same thing, let me define what we mean by log length and overlength.

- Log length: here we are speaking of producing the correct log length for the lumber sizes marketed. In other words, producing the correct nominal length log plus the minimum trim allowance required.

- Overlength: is any length in excess of the sum of the nominal log length plus the required trim allowance.

To illustrate what we mean, we have the case of the mill selling lumber on the even foot (8-10-12-14-16). Measuring the logs we find a log cut 12 feet 9-1/2 inches. In this case, the log should have been cut 12 feet/5 inches. As cut, this log has 4-1/2 inches of overlength. Another log is 11 feet 10 inches; this log length is not desired. In this case, the overlength would be 11 feet 10 inches - 10 feet 5 inches 17 inches.

This is an extreme example, but logs such as this, which are bucked just short of the nominal length, are especially detrimental because lumber must be trimmed back to the next nominal length which is usually two feet. This represents 12.5 per cent on 16 foot lumber. Excessive overlength and improper log length are costly.

Firstly, lumber recovery is lower from these logs as this extra length is usually trimmed off and chipped. No additional lumber is produced from the overlength.

Secondly, this extra log length consumes expensive processing time without producing any additional lumber. This reduces throughput and increases processing cost per log.

Finally, producing the correct length initially would occasionally allow a longer last log to be cut from the tree length. It also results in a slight increase in the small end diameters of subsequent logs. Occasionally, this diameter increase will put this log in the next higher diameter sort class resulting in increased recovery. During one study, we found the trim allowance on the study logs averaged 6.9 inches if odd log lengths were acceptable. As the mill was not producing odd length lumber, our average trim allowance increased from 6.9 inches to 8.6 inches. Now, let's assume all the logs could be cut the proper length and with, say, an average trim allowance of 5 inches. The excess overlength 3.6 inches (5.0 inches to 8.6 inches) would be saved and lumber recovery would improve as shown in Table 1.

You can see that eliminating the overlength produced a 1.7 per cent increase in the Lumber Recovery Factor (LRF). What does that mean to an operation cutting 25 MMfbm/year? (Table 2).

The 1.7 per cent increase in recovery translates into the production (425 Mfbm) of additional lumber from the same sawlog resource. There is no additional resource or sawing cost associated with this additional lumber. In calculating the value, we have assumed a shrinkage and planer mill loss of six per cent. As well, we subtracted $14/Mfbm for drying and $26/Mfbm for planing from our selling price of $240/Mfbm. The lumber value increase totals about $80,000. When we subtract the value of the lost chips, we obtain a net benefit of almost $50,000 per year.

The third point under log quality refers to debarking. A lot of money can be made or lost at the debarker. Too much bark in the chips and you lose the premium or, worse yet, the chip contract. Too much fiber removed here is lost for good. Complicating this matter is the desire to increase lumber recovery. If we increase lumber recovery, less wood fiber will end up as chips from a given tree volume. If debarking efficiency does not increase at the same time, then the relative percentage of bark will increase in the chips. There is a fine balance here between too much and not enough. If we haven't achieved this balance, how much can it cost? We used the Best Opening Face (BOF) program to simulate the effect of log diameter reduction due to excessive debarking.

A 6.4 inch diameter log, 12 feet long with two inches of taper should yield 27 fbm of lumber if the log is sound and straight. This is based on the BOF sawing solution for split taper, log and cant sawing and a 1.875 in. target size (Table 3). You can see here that if the debarker is removing a tenth of an inch too much of good fiber, that same log would yield 11 per cent less lumber. What can this mean to our operation producing 25 MMfbm per year? (Table 4)

Let's assume that we do not recover the full potential of 11% on every log. Let's assume four per cent, or say one log in three. The same logs should yield an extra 916,000 board feet of lumber. Using our net value of $200/Mfbm to allow for drying and dressing of this additional lumber, this lumber is worth $183,000. What the net benefit to the operation would be is very dependent on how well we can balance our bark and chips, but it is certainly worth a look. Don't forget that we only increased lumber recovery on every third log. There would be additional wood fiber on the other two logs which might be recovered as chips.

The next major area I want to discuss deals with Log Allocation. In this area, we are looking at

- yield or lumber recovery by production line;
- productivity by production line; and
- profitability by diameter.

The first two obviously involve the case of optimum allocation of sawlogs between two processing lines. This is a very important step in any two-line mill. Logs must be processed to achieve maximum overall mill recovery and productivity.

We feel, however, that log allocation is just as important in a single line mill. It is important to process only profitable logs. I would like to share two examples with you to illustrate these points.

The first example involves the two-line mill. One line was for logs less than seven inches while the other line was for the larger logs. During our study, ten per cent of the logs on the large log line were under the seven inch sorting guideline and 20 per cent of the logs on the small log line were over the seven inch sorting guideline.

The optimum allocation between the two lines is shown in Table 5.

You can see that proper allocation of logs between the two lines would increase the overall mill Lumber Recovery Factor by four per cent. Based on an annual production of 48 MMfbm, this increase would result in the production of an additional 1,930,000 fbm of lumber from the same sawlog volume (Table 6). Again, we have assumed a drying and dressing cost and allowed for shrinkage and planer mill losses in coming up with the additional lumber value of $363,000.

There will be a loss of chip revenue but the next benefit to the operation was still calculated to be over $200,000 as can be seen.

How about that single-line mill? If you remember, for that mill we were talking about profitability by diameter. What are the potential benefits?

These are log sizes in mills which are processed and produce no lumber. This is a very expensive way to make chips. There are also log sizes which, because of their small size, require far too much expensive headrig time per Mfbm of lumber. The result is log sizes which are processed at a loss. The production cost for these logs far outweighs the product value generated by those same logs. Table 7 shows us an example of this situation.

Before anyone gets nervous, these numbers were calculated at the bottom of the recession. Since then, lumber prices have risen but this operation still has to process about 280 three inch diameter, eight foot logs to produce a thousand board feet of lumber. The mill did not have any more available resource. Any decision, therefore, to chip these logs would reduce annual lumber production. The result of chipping rather than sawing those unprofitable logs is shown in Table 8.

As you can see, the decision to chip those two small diameter, short length sawlogs saved enough in sawing costs to produce a net benefit of just over $100,000 per year. This operation did not have to make any investment to facilitate chipping of these logs.

The benefits would be significantly higher, however, if larger, profitable logs could have been processed in place of those small logs which were chipped.

Optimum Log Breakdown

We all know the cost of delivered wood is rising and of the need to maximize recovery. We have already seen examples of the potential benefits available due to small increases in recovery. The important point is that the log breakdown process is only one step that affects the final yield. You could have the best computer controlled log breakdown system, but it will only be as good as the processes before and after it. Computerized headrigs are very good in that they minimize the chance of losses due to operator error. As well, it can allow management the opportunity to optimize on value which can be a big advantage in terms of marketing.

But any computerized log breakdown system will be very dependent on two important factors:

- efficiency of the scanning system;
- efficiency of diameter sorts to sawing diagrams.

Remember the 11 per cent difference in recovery at the debarking stage due to the difference in diameter? The same thing can happen at the headrig if scanning or sorting is less than ideal.

Minimize Lumber Size

What we mean here is producing the smallest possible rough, green size required to give us the final dry, dressed market size. To achieve this, we have to think about three things.

- sawing variation
- target size
- quality control monitoring

We have to establish a realistic minimum target size. Then we have to stick to it, not just for a week, but on an ongoing basis. Therefore, we need quality control. If we follow these steps, our target size should allow us to eliminate any oversizing.

Figure 1 shows what we mean by oversizing. We carry out thickness analysis to determine sawing variation. Once we know this, we start with our final market size and add to it. We add allowances for planing, shrinkage and sawing to come up with the minimum target size. The amount (either thickness or width) by which our lumber exceeds this target size is called oversizing. This additional fiber is lost as lower valued planer shavings. What we want to do is eliminate this oversizing so that this fiber may be recovered as additional higher valued chips and lumber. It is doubtful in eastern Canada that elimination of oversizing will result in the production of extra boards because of the small log diameters. However, elimination of oversizing can result in the production of longer, wider or thicker pieces of lumber.

Figure 2 shows how the elimination of oversizing increases lumber recovery. In this example, the elimination of less than 1/16inch in the target size allowed the length of the top two by four to increase from 12 to 14 feet. This translates to a recovery gain of 2.6 per cent.

Most mills target 17/8 inch for two inch lumber; some mills go down to 113/16 inch, but this is about the lowest we see. With proper quality control checks and low sawing variation, we have generated some target sizes as low as 121/32 inch (1.656). Our colleagues at the Western Laboratory in Vancouver are now seeing target sizes on gang edgers and Chip-N-Saws of 111/16 inch (1.687) to 123/32 inch (1.718).

What does this mean to an eastern Canadian operation cutting 25 MMfbm a year? Let's assume that after a lumber size evaluation, the company finds they can reduce their target size from 1 7/8 inch to 1 13/16 inch. In other words, reduce oversizing by 1/16 inch. Let's also assume that only one-third or 33 per cent of this oversizing is recovered as lumber and the remaining two-thirds as chips. The benefits of this change are shown in Table 9.

Based on a production of 25 MMfbm (rough green), the reduction in oversizing would result in the production of an additional 213 Mfbm of lumber with no increase in sawlog volume. This lumber, after allowing for shrinkage losses plus drying and dressing costs, would have a value of over $40,000. Adding the value of the additional chips results in a total net benefit of $68,000 annually.

My last topic is improving productivity and two factors need to be considered.

- Down time
- Delay time

Productivity is the "name of the game" and down time is crippling in terms of cost, but what I would really like to discuss is delay time. This is different from down time. Down time affects the time during a shift when a machine is available for processing. Delays, on the other hand, are short duration interruptions when the machine is available but not actively processing material due to operational or mechanical problems in the mill flow. It reduces the rated capacity of a machine, it can lead to operator frustration, and it is much harder to detect.

Because they are short duration delays, they are easily overlooked during a shift but they sure affect the total production. Delays that we have meausred at the headrig have ranged from less than one per cent to over 17 per cent. Usual causes for delays at the headrig include:

- lack of material;
- log handling delays;
- log jams at unscrambler;
- surge deck overloaded downstream;
- chipper jam.

What do delays cost? (Table 10) We have assumed that we could reduce delays by ten per cent with minor modifications. This would increase production by at least ten per cent as delays only affect the productive machine time. When we amortize the sawmill operating cost over the increased production level, there is a $7.27/Mfbm decrease in sawing cost. On an annual basis, this amounts to a $199,925 savings. The only cost involved would be the cost of any modification.

That concludes my run through the mill. The total benefits are shown in Table 11.

You can see that some sizeable benefits are available to our operation cutting 25 MMfbm a year. A lot of these improvements require some hard work, applying a little science and lots of common sense, but there is room for improvement.

* * *

Table 1

Current Milling Conditions

	Log Volume (cf)	Lumber Tally (bf)	Lumber Recovery Factor	LRF Improvement (%)
Study Logs With Overlength	2847.2	18,222	6.40	—
Study Logs Without Overlength	2798.8	18,222	6.51	1.7

Table 2

Benefits From Reduction in Log Overlength

Annual Production	25 MMbf
LRF Increase	1.7%
Additional Lumber Volume	425 Mbf
Additional Lumber Value at 425 × .94* (240 - [14 + 26])	$79,900
Reduced Chip Value $\frac{425,000}{12bf} \times \frac{45.6}{2000} \times \$70/ODT$	$31,700
Net Benefit	$48,200

* shrinkage 6%

Table 3

Increase in Lumber Yield Using Correct Debarking Technique

Log Diameter (in.)	BOF* Yield (bf)	LRF	Difference (%)
6.4	27	7.22	—
6.2	24	6.42	11.1

6.4 log
12 foot long
2 inch taper
split taper log and cant sawing
* based on a target size 1.875

Table 4

Benefits Using Efficient Debarking Technique

Annual Production	25 MMbf
LRF Increase	4%
Additional Lumber Volume	916 Mmfb
Additional Lumber Value at 916 × .94* (240 - [14 + 26])	$172,200
Reduced Chip Value	—
Net Benefit	$183,000

* shrinkage 6%

Table 5

Potential Lumber Recovery Improvement

	Small Log Line LRF	Large Log Line LRF	Mill LRF	Improvement (%)
Study Log Allocation	5.51	5.98	5.77	—
Optimum Log Allocation	5.64	6.31	6.01	4.0

Table 6

Benefits From Improved Log Allocation

Annual Production	48 MMbf
LRF Increase	4.0%
Additional Lumber Volume	1,920 Mbf
Additional Lumber Value at 1,920 × .94* (240 - [14 + 26])	$36,000
Reduced Chip Value $\frac{192,000}{12bf} \times \frac{25.6}{2000} \times \$70/ODT$	$143,000
Net Benefit	$218,000

* shrinkage 6%

Table 7

Net Product Values ($/Mbf)

Log Diameter Class (inches)	Log Length 8 feet	12 feet	16 feet
3	-215	-109	-61
4	-174	-143	-40
5	-40	13	39
6	7	37	46
7	42	57	70
8	75	—	92
9	86	—	121
10	101	—	—

Table 8

Benefit of Chipping Some Unprofitable Sawlogs*

Processing Logs for Lumber		
Annual Production	25MMbf	
Chip Production (ODT/year)	1,420	
Total Product Value ($/year) (Lumber, Chips, Residues)	308,500	$308,500
Processing Logs for Chips		
Chip Production (ODT/year)	2,920	
Value of Chip Production ($/year)	225,000	
Savings in Sawing Costs ($/year)	177,600 (49 shifts)	
Savings in Planing Costs ($/year)	20,300	
Total Value of Chipping ($/year)	422,900	$422,900
Net Benefit (Chipping)		$114,400

*chipping 3 and 4 inch diameter × foot sawlogs

Table 9

Benefits from Reduction in Oversizing Lumber

Annual Production	25 MMbf rough green
LRF Increase	1.1%
2 inch Lumber Production	80%
Additional Lumber Volume	213 Mbf
Additional Lumber Value at 213 x .94* (240 - /14 26/)	$42,600
Additional Chip Value at 427 ODT x $60/ODT	$25,600
Net Benefit	$68,200

* shrinkage 6%

Table 10

Benefits from Reduced Delays

Annual Production	25 MMbf
Operating Cost (Sawmill Fixed and Variable)	$2 MM
Sawing Cost/Mbf	$80/Mbf
Delays	10%
Additional Lumber Volume	2.5 MMbf
Reduced Sawing Cost ($80/Mbf - $2MM / 27.5 MMbf)	
Sawing Cost Savings ($7.27/Mbf x 27.5)	$199,925
Net Benefit	$199,925

Table 11

Total Benefits for a 25 MMbf Sawmill Operation

Elimination of Overlength	$48,200
Improved Debarking	183,000
Improved Allocation	114,000
Minimize Lumber Size	68,200
Reduce Delays	220,000
Total Net Benefits	$633,400

FIGURE 1.

THE COMPONENTS OF A TARGET SIZE

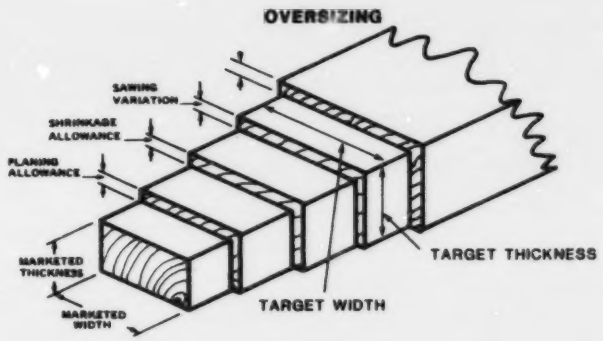
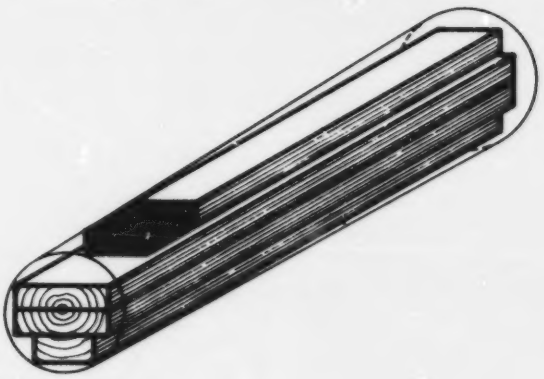


FIGURE 2.

ELIMINATION OF "OVERSIZING" OR THE REDUCTION OF LUMBER THICKNESS TO IMPROVE LUMBER RECOVERY



Improving Yield at the Headrig Through Computerization

D.E. Gorman and E.V. Persaud
ADI Limited

The Devon Lumber Co. Ltd. operates a sawmill and fence manufacturing plant at Gibson Street, Fredericton. This mill has two headrigs one a double twin for cutting logs of five inches to ten inches; the second is a rotary saw and carriage where logs of ten inches and over are processed. All output from the headrigs passes through the edger and the trimmer to the green chain for grading and recording. A resaw is utilized to recover product from some of the slabs. The output from the mill is 35,000 to 40,000 board feet/shift.

At the present time this mill, like many in the province, determines productivity or yield on a historic basis. Over a period of time they know approximately the volume of logs entering the mill and have a reasonably good record of sawn lumber over the green chain, plus the amount of chips and a rough approximation of sawdust. From this data, a yield can be developed; however, this is historical only since, in all probability, some days or even weeks may have passed before sufficient information is available to provide a meaningful guide.

Yield is a ratio of input, in terms of logs, to output of marketable products. Between the logs 'in' and the products 'out', there are a number of decision areas where operators must act quickly and with a high degree of competence.

Decision areas in the Devon Lumber Co. operation include:

- Sorting at infeed deck where logs are sorted as to size and quality and directed to the post and rail plant (another section of the company's operation), pulpwood, the sawmill or rejected.
- Sorting after the debarker as to size, with the larger logs directed to the rotary saw and all others to the twin saw.
- Selection of cuts in the larger logs passing through the rotary saw.
- Selection of cut at double twin saw.
- Saw setting at edger.
- Trimming to length of finished stock.

As for speed and accuracy of reporting, it is desirable that management have on short call a reading of logs 'in' with size and species and of lumber 'out', based on volume, as well as an indication of what the optimum yield should be, given efficient decisions at each decision point. The motivation for improvement in the areas noted is higher yield, need for a better system of reporting and greater return on your investment; competition is fierce and an operator must produce at a high level of efficiency to stay in the business.

In analyzing the problem, we turned to the computer concept because of its capacity for rapid computation and displays. Our investigations revealed that equipment is available for virtually 100 per cent automation of the sawmill operation; however, if one was to use this approach with our small log mills in the eastern part of the country one would soon go broke. We found the capital requirements to be very high, relative to throughput.

We concluded that a hybrid system using computer and graphics, with a strong input from key positions in the production line, offered a relatively low cost and highly effective system.

It is recognized that sawmill operators have a very good understanding of their basic machines and the product but often have a fear of 'black boxes', especially when these units control a portion of their process. There is reason for some concern, however,

since the quality of computer hardware marketed today is high, costs are dropping and servicing and maintenance of systems is much less sophisticated than it would appear. The systems are manufactured in modules which can readily be checked out and replaced when defective. This, then, is the first hurdle to overcome; if you are convinced of its value and are keenly interested in using it, you can make it work.

It is common knowledge that large sawmills have, for some time, successfully applied automation techniques to measure, record and control various production stations in the sawmill to improve and control yield, productivity and product quality. To a lesser degree, some of these techniques have been applied with varying degrees of success in smaller scale sawmills typical of those found in eastern Canada. Emphasis is placed on locally developed, custom-fabricated systems. This is due mainly to the fact that most of the commercially available systems manufactured in the U.S. have been designed for larger operations and, in some applications, to conform to particular product flows. Also, these systems have been designed to deliver accuracies beyond the requirements of the Devon lumber mill and are reflected in their costs. For example, some commercial scanning systems discriminate log diameters to within 0.1 inches, whereas a one inch discrimination would likely be adequate in this application.

In our analysis to determine the extent of automation, we concluded that the main thrust should be directed into these areas of interest:

- An automated log-scaling system.
- An on-line saw-cutting optimization system.
- A lumber-tallying system.

All of these would be intergrated into a centralized management information system.

Log Scaling Systems

As previously stated, small logs are directed to an adjustable twin saw and larger logs are fed to the rotary carriage saw. This discrimination of logs as they leave the debarker is presently done by estimating the log diameter and manually directing the logs to the appropriate stockpile. A log-scaling system would, therefore, have to measure the length, diameter and taper of the logs. Such data could then be utilized to compute the maximum yield possible from any given log and subsequently offer a method of achieving such yields.

Much of the technology involved in commercial systems is tied up in defining the taper of the log. At Devon, the taper of the logs does not represent an imperative parameter for optimization because the logs are relatively short (about eight feet).

The proposed log-scaling system would therefore be made up of strategically located limit switches with an appropriate operator and some photoelectric devices. Two such systems, one at the carriage saw and one at the twin saw, would measure the length of the log and its minimum diameter. This data would be accumulated in a microcomputer for providing management with a record of the quantity, type and dimensions of logs entering the mill. Such information for logs fed to the adjustable twin saw would be translated to an operator prompt of the best position of the saw for that log.

Sawyer-Assist System

Research into the maximization of dimensioned lumber indicates that the position of the first saw line on the log or the cant establishes the position of all others. This criteria forces a crucial decision on the sawyer, since the first cut prescribes the basis of a sawing pattern that can either maximize or minimize yield and/or lumber value. This research has also spawned the theory associated with the Best Opening Face (BOF) method of breakdown.

The BOF method takes into consideration various parameters of the log and sawing equipment in order to decide where to place the first cut in the log and to select a sawing method that will maximize yield. The parameters of the log derived from a log-scaling system serves as an active input to this system.

Some of the variables considered in the BOF approach are: lumber sizes, planning allowance, shrinkage, saw variations, kerf width, sawing method, log taper, setting increment capability of the sawing equipment, etc. It can be appreciated that an accurate decision based on these variables is no trivial task. Hence, the BOF techniques have been implemented as computer programs for quick decisions on optimization.

It has been acknowledged that a good sawyer can, based on his years of experience, make the correct decisions for optimum yield at the beginning of his shift. However, his accuracy diminishes as the shift progresses. A good sawyer, coupled with an optimizing program (BOF), can therefore make for an excellent system, the sawyer being available to make decisions when abnormal conditions arise.

The BOF system can therefore be used as a sawyer assist; the computer would accept the system and material parameters and display patterns to be executed by the sawyer. This 'assist' system would display to the carriage saw operator. These figures

would be stored in the memory of a microcomputer and would be displayed, depending on the type and minimum diameter of the log to be sawn. The sawyer would then follow the recommended cutting pattern for yield optimization.

At the adjustable twin saw, the diameter information derived from the log-scaling system would be translated to an operator prompt of the best position of the saws for each of the approaching logs in succession. A laser line system could serve as visual confirmation of the computer's decision and to assist in adjusting for any log profile irregularities not detected by the diameter-measuring system.

These laser guide lines at the adjustable saws would be mounted above the infeed conveyor to the adjustable saw and would prescribe a line(s) representative of the cut on the log. These lasers would be mechanically linked to the saws so as to track their positions. These devices would augment the interaction of the log-scaling system and the adjustable saw.

Lumber Tallying System

Lumber tallying takes place during the final stages of lumber production. This phase of the activities has traditionally been a manual endeavor, with someone assigned to evaluate, by visual estimation, the length, thickness and width of the finished pieces. Having determined the classification of the lumber, it is necessary to place it in the appropriate stack and then to make a record of that piece. In some situations, it is also necessary for that person to trim the lumber to the proper lengths. As can be appreciated, this method of tallying is by no means exact because of the monotonous nature of the activity and the extent of manual involvement.

Microprocessor or computer-based lumber tallying systems relieve monotonous tasks and at the same time decrease errors incurred in manually logging this information. Such systems provide management with up-to-date information on stocks and makes available a more accurate assessment of the yields. Such systems may be extended to incorporate a method of automatic sorting and storing of the finished product.

The system proposed will have electromechanical and photoelectric sensors connected to a microcomputer via an interface. It would fulfill all the functions of a lumber tallying system. The microcomputer used in the log-scaling system would be used to service this operation and could evolve as a true management information system if the applicable software was developed for this application.

Management Information System

Computers have been employed as management information generating tools extensively in the business environment and have now become essential tools for planning. Recently, however, this tool has been gaining prominence in the sawmill industry.

As opposed to the other computer systems previously discussed, which initiate some form of immediate active function, a management information system gathers data from various parts of the mill production line, formats it, perhaps executes some statistical analysis on the data and presents it to management in a form conducive to ready assessment of mill performance. In short, a management information system can be realized by a computer and some software packages (programs).

Some of the questions that a management information system can answer (or assist in answering) are:

- What is the relation between log input and lumber output with respect to cost and yields?
- What diet of logs provides the best economy?
- How do various breakdowns affect efficiency?
- What are the benefits of changing the product mix within the mill?

Other figures relating to some analysis of the inputs and outputs can also be generated. This, as was mentioned earlier, is a software package and mill management may request additional features not encompassed in the standard package.

Although these programs may consider a wide collection of variables and other related data for their mathematical evaluation, it must be emphasized that these outputs are mere numbers on a page and still require the educated judgement of an experienced sawmiller to formulate appropriate production decisions. Figures 1 and 2 are typical of the kind of data that sawmill management information systems can provide to assist in the continuing daily, monthly and annual evaluation of the sawmill's performance. Custom software can tailor each system to best meet the needs of the specific sawmill.

For the Devon Lumber Co. system, assuming that the information gathered by the log scaling, sawyer assist and lumber tallying is fed into the computer, the following information would then be available to management in the form of video-displayed text. Information displayed on the video terminal can also be presented in hard-copy format via a printer.

Figure 1

DATE: 00/00/00
TIME: 00/00/00

DISTRIBUTION REPORT

	8'	10'	12'	14'	16'	18'	20'	Diameter Total	Average Diameter
5.0 - 5.9 In.									
Pieces	0	0	0	0	0	0	0	0000	0.0
Volume	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
P.BD.FT	0	0	0	0	0	0	0	0	
6.0 - 6.9 In.									
Pieces	0	0	0	0	0	0	0	0000	0.0
Volume	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
P.BD.FT	0	0	0	0	0	0	0	0	
(More Data Can Follow)									
Pieces	0	0	0	0	0	0	0	0	
Volume	0	0	0	0	0	0	0	0	
Proj. Lumber	0	0	0	0	0	0	0	0	
Avg. Length	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Figure 2

Typical Distribution Report Form

DATE: DD/MM/YY
TIME: HH:MM:SS

SUMMARY REPORT

Report From _____ To _____ No. Shifts _____

TOTAL

Logs Scanner 000000
Logs Manual Mode/Overriden 00000

Log Volume (Cubic Feet) 0000000.0
Log Lineal Footage (Feet) 0000000.0
Projected Lumber (Board Feet) 00000000
LRF (Proj.) 00.00

AVERAGES

Cubic Volume Per Log 0000.0
Small End Diameter 0000.0
Length 0000.0

PRODUCTION

Report Duration (Minutes) 00000
Minutes Per Log (Duration/Log Scanner) 0000.0
Downtime/Idel Time (Minutes) 0000
Machine Productivity 00.0%
(Duration-downtime) /Duration

Included in the type of information which could be made are:

- Number of logs entering twin saw.
- Number of logs entering carriage saw.
- Length of logs.
- Diameter of logs.
- Volume of logs.
- Equivalent cords of logs.
- Average diameter.
- Distribution of input logs by diameter.
- Theoretical yield per shift.
- Quantity, length, width and thickness of dimensioned lumber tallied.
- Actual yield per shift.
- Summary of production by shift and associated information.

Since the format of the video-displayed and printed information is primarily dependent on software, there is great freedom in tailoring this format to the needs and preferences of management, the only real limitation being the quantity and accuracy of the measured data, i.e. length, diameter(s), width, thickness, quantity and other data.

In addition to the data available from the systems described herein, a management information system could also accommodate the input, recording and displaying of other parameters in the raw material balance equation. For example, such items as weight of sawdust, chips, bark and shavings could be accommodated, the only requirement being that means be provided for measuring these variables and that the information system be configured with these expansion capabilities in mind. Other parameters which have been accommodated in past installations include machine downtime, mill downtime, categorized into such things as broken blades, machine jammed, burnt motors, coffee breaks, bottlenecks, and other problems.

The cost of the proposed system is in the vicinity of $75 000. This figure includes an allowance for rearranging and making changes to some equipment such as conveyors, transfer decks, etc. Also included are hardware, software, engineering and installation costs. It should be noted that a precise definition of software functions for the management system has not been established and that both software and related hardware estimates for this year are based on basic management information. However, the estimated system could be expanded to accommodate a more sophisticated management reporting system.

* * *

Computerized Sorting Systems

Howard Borer
North American Controls Inc.

I will begin by describing the course that the board follows as it enters a jay bar lumber sorter as we at North American Controls control the machine. The computer controls the process, starting with the lug loader, and will fire the lug loader and load a board in every lug space except under three conditions; the operator has turned off the lug space because perhaps the prior lug has two or three boards in it, there is a board recirculating around the jay bar because one of the bins is full and there is no other bin available for backup, or the operator has indicated that one of the jay bars is locked out because it is broken and the computer knows that it should not load a board into it. Barring those three conditions, the lug space will have a board in it. It proceeds along past the operator, who stands at his console entering the grade of each board.

Our computers sort lumber based on four attributes; grade, thickness, width and length. Some mills do not grade lumber in the sawmill. They use three grades as a species separation capability. The computer could separate cedar from spruce in that way. Some systems control an automatic end trimmer. In that case the operator would also enter near and far end trim information. He might even slash the board, or not trim it for various reasons. All that information is entered by the operator in his operator entry zone. The board goes through the trimmer, if there is one, and is brought over to the lumber line where it enters the sense zone.

The sense zone consists of length measurement switches and also sensors for thickness and width. There are two basic techniques for measuring the thickness, the first of which involves just a set of cam switches. A one inch board would open and close with the first cam. If the board is thicker than that it would open and close the first then proceed on and open the second cam. The computer just looks at the number of cam switches that are opened to determine the thickness of the board.

A second way of doing it, which is much more accurate, is to put a shaft encoder in this position. The width is measured with a photocell. There is a transmitter on the bottom and a receiver up on top. When the leading edge of the board breaks the photocell we start counting the shaft encoder pulses until the board leaves the photocell then we stop counting.

Once we are past the sense zone the next lug space is the one we call the 'assignment point'. That is where the computer takes the data previously entered and looks up a sort table to figure out which of the various bins this board is going to go into. The operator has to enter which grade, thickness, width and length or combination of these zones goes to each of the bins and how many pieces make a full package. The computer assigns each board and when it arrives at the correct bin it fires the diverter and counts the number of pieces in the bin. When the number of pieces equals the full count assigned by the operator then the package is full. When a diverter fires for the last board the 'bin full' light comes on. Then the operator lowers the bin and empties the lumber. When the bin comes back up to the top the computer receives an input signal, knows the bin is empty and the process is repeated. When the bins are full the computer has the ability of seeking out a new empty bin. If there are no available bins it will automatically recirculate until the bin becomes empty and then they will start dropping again. It keeps track of how many boards are recirculating per each package so that the count is always correct. That essentially is the sorting process.

There are several advantages to the computer systems. The four that I would emphasize are: speed; the information the computer can give you besides just controlling the mechanical process; the maintenance aids it can provide to help you keep it running; and information on quality control.

In terms of speed, not very long ago 60 lugs a minute was a fairly fast system. That is no longer true and fortunately the electronics have been able to keep up with the demand of the sawmill industry for faster systems. I just came back from Port Gamble in Washington state, where we have a bin sorter with a three saw trimmer running constantly at 85 lugs a minute. We are sorting lumber at that speed without any problem. Another way to speed up the process is to have two infeeds feeding the same sorter. That way each of the operators is handling boards up to 60 lugs a minute but the sorter is running twice as fast. Consequently, you can keep the accuracy of the operator information at a reasonable speed so he can do a fair grading job and you can also get a lot more pieces into your sorter.

A system we are going to be starting up in a month or so deals with cases where one or the other of the infeeds may drop out at any given time for various reasons such as a jam in the trimmer, or an operator has no lumber. In this system each of the infeeds is controlled at a variable speed. There is a programmable controller that is going to match the speed requests of the two infeeds and make sure that the sorter is running a little bit faster than the two operators want to run. Suppose one of the sawmills feeding the infeed runs out of wood for five minutes. That operator will turn his infeed off. The programmable controller will see that the sorter does not have to run at 125 when only one infeed is running at 70. It will slow the sorter speed down to about 72 lugs a minute if the other infeed is running 70. If the other infeed is running 50 it will slow the sorter down to 52. The idea behind the system is that each operator indicates how fast he can run comfortably. The programmable controller will control the speed of the sorter to match the two infeeds. If you have a speed requirement, our computer configurations can probably agree with it.

There are various factors that allow us to control for speed. The faster the chains are running, the sooner we will fire the diverters on the bins. At 10 lugs a minute the mechanical lag on a diverter solenoid is no problem. At 85 lugs a minute it is. We automatically advance the firing of diverters so that boards are not missed at higher speeds. Similarly, we will advance the firing of the lug loader. We have parameters that allow you to adjust the measured width of each board. The faster the chains are moving the finer the adjustment, thus we keep the width of the boards accurate regardless of chain speed.

If the power fails in the mill, the computer automatically turns off all the outputs and issues a command to stop the chains. In this way the chains do not continue to move with lumber on them and we do not lose track of the position of each board because the power has been turned off. The computer tells the sorter to stop moving and that way there will not be any untracked travel except for the amount of coast built into the system. We have parameters that allow you to inform us of how fast a system is going to coast on a power down. When the power returns the computer electronics are such that it automatically comes up running. No one has to restart the computer. The computer memory has recorded the speed at which the chains were moving when the power went down. It adds a speed adjustment factor into the position of all of the boards on the chains, thus when the operator re-starts the sorter after the power failure the position of every board is known and they are not missorted.

On the typical sorters that we have dealt with, lug space is about 34 inches per lug. The lug space is divided into 500 pulses with our shaft encoder so we are monitoring about every two per cent of a lug space which gives us about two-thirds of an inch. Each board is tracked through all of the positions in the sorter to within two-thirds of an inch. A fairly accurate job can be done at any speed so we do not lose track of the boards.

One of the real advantages of the computer is the information it provides. Programmable controllers will control sorters. The real advantage to having a computer, in additon to the various configurations in which you can control the information is that it helps the manager do a better job of running the mill. I am going to discuss four specific examples of information; the lumber tally, a shift statistics report and a diagnostic report, to help you identify the errors during a shift and, in addition, a ticket printing system.

Figure 1 shows a lumber tally report. In this particular report this mill is running 8, 10, 12, 14, 16, 18, and 20 foot lumber. The lengths are across the top. For one-by-four, there are 22 pieces of one-by-four making 103 board feet. For every length and every product that was graded as grade 1 it will give you the number of pieces and the board footage during the shift. This report can be done anytime, even when the sorter is running. Typically however, it is taken at the end of the shift to let everyone know the volume and piece count of lumber through the machine for that shift. At the bottom of the first grade are totals for this one grade. The same configurations are repeated for grade 2 and provide the totals for grade 2. The last two lines of the report show totals, by length, for all the grades. In the lower right corner is the grand total, total pieces and total board feet for the tally period. These are essential bits of information in the running of a sorter.

The shift statistics report (Figure 2) is the first piece of real management information provided by sorter systems. These numbers are real. They come from

that mill in Port Gamble, Washington. They are running a different class of log so the numbers may seem strange. In this system, at the end of 6-1/2 hours there were 14,375 pieces or 270,000 lineal feet, 233,000 board feet of lumber. The first line shows the total time into the shift. There is a clock in the computer that runs all the time. One of the parameters you give the computer is information on when the shift begins and when it ends. This information lets the computer know when to start and stop the tally information. The computer must also be informed of the time and length of scheduled breaks such as lunch and coffee breaks. The total time into the shift is 393 minutes. This report was taken at 14:33. In this mill they take 60 minutes for lunch and a 10 minute coffee break in the morning, that is 70 minutes of legal break time. The total available run time so far is the total time into the shift minus break time, 323 minutes of available run time. During that amount of time we ran for 274 minutes and were down for 49 minutes for a downtime of 15 per cent.

These are very useful items of information. If you review that information over several weeks and it is fairly consistent you have a feeling for what a typical run in your mill is. If the numbers start varying you will have to find out why. We had four idle periods in this time for an average idle period of 12 minutes. This sounds like there are some breakdowns. We had 18,630 lugs run through the sense zone during this number of minutes and there were 14,300 pieces. They are running about 4,000 lugs empty over that period. It would appear that 20-25 per cent of the lugs going through the sense zone are empty. I would like to know why they are wearing out the machinery. One out of four lugs does not do any good at all. Either get more lumber into the sorter or slow down.

Figure 3 shows a diagnostic report. There are approximately 100 possible errors built into the computer's memory and the computer tallies the number of times each error occurs during a shift. This is a hypothetical example. There were 537 set pieces through the sense zone and three power failures during the shift. Boards that get caught in the sense zone going through the photocell for width measured during a power failure are sent to the reject bin. If the power is off you cannot track the shaft encoders. The board width is unknown therefore the board is rejected. Another possible error message could be the number of skewed boards, the number of boards that had bad width, or bad thickness and instances where the operator misjudged the grade. At the end of a shift the error counts are cleared and a fresh start is made for each shift.

Maintenance aids are listed in Figure 4. To help maintain the hardware our system is wired so that all 110 signals from the lights and buttons do not have to be brought all the way back into the computer room. They stop at what we call remote stations. These are boxes on the sorter which condense up to 64 inputs and outputs. That information is sent back over a low voltage cable to the computer room. This not only facilitates maintenance but also decreases the cost of wiring.

Each channel has an on/off and automatic switch which allows you to do a diagnostic check right out on the sorter. For example, if a diverter is not firing, the output signal to that diverter is wired through one of these three positions switches. If you put the switch in the 'on' position and the diverter does not fire then you have a problem between that card and the diverter itself. The problem is somewhere between that switch and the diverter. Similarly, if lengths are mismeasuring, go out and trip the limit switch for the corresponding length and the LED on the input channel should come on. If it does not then there is something wrong between the input switch and the input card. There are 16 of these cards in the remote station, each one has four channels totalling 64 IO's in a remote station. Each of these channels has an on/off and auto position which is how all the diagnostic work is done. There is also a red LED that will illuminate if someone pushes down a grey button. It is a very good diagnostic tool. The width measuring photocell has a little red light on it indicating when the photocell is out of alignment or adjustment.

Various software aids built into the program help keep the system running. The diverter test is a program where three characters are typed on the keyboard and it turns on the full light and fires the diverter for bin one. One half of a second later it turns off the diverter and the light and proceeds to bin two, repeating the procedure on down the line to the end of the sorter and then begins again. These exercises for all diverters and solenoids make sure that all the lights work and run at the same speed. A man can walk along the catwalk verifying that all the electronics are working well.

We have programs that allow you to check that the shaft encoder is working properly. It is also possible to monitor every instrument at the terminal. If someone said the boards are not being graded right, the operator can push the grade button and print on the terminal. It will print when it goes on and when he lets go of the botton. Output can be verified by firing any output, a diverter, or 'bin full' light from the computer by typing a command. You turn it on and make sure the diverter comes on then turn it off, which verifies all the electronics in the program from the computer terminal, into the cabinet, all the way through the wiring and the remote station, out to the diverter. There is a built in check in the program. If you type a couple of characters the computer will automatically run a complete self check. If something has changed in the computer's memory it will tell you.

If nothing has changed it prints 'okay' and you have to look somewhere else for the problem.

The standard computer looks like a typewriter. It has a keyboard for input, but more important it is a typewriter printer device. In the computers in a sawmill application it can be used as a ticket printer. The computer knows every load of lumber that comes out of the sorter. It knows how many pieces there are, their thickness, width, length and grade. It prints a ticket for every package that comes out of the sorter. Every load that goes to the customer has a computer tag on it. The example in Figure 5 has one cardboard copy underneath tissue paper-like copies on top. The hard copy gets stapled to the load. The soft copies are distributed to billing, sales and the shipping departments in the office. This process allows for complete control of inventory. The tickets are printed automatically every time the diverter fires the last board of the package. The ticket printer is located down by the stacker so that when the load comes to the stacker it is torn off and stapled to the package. We have installed these tickets in systems where there is no sorter.

Some mills in the mountains of Idaho and Montana run random width lumber. Each piece has to be hand tallied. In this case the system automatically measures the width of the random width boards with a photocell. The thickness and length we are good at. The operator enters the grade and we build the packages that are going to the pull chain. Every time a package is complete on the pull chain a ticket is printed for these random width loads. This reduces the need for one tally man per shift.

Accurate thickness measurement is the basis of a good quality control program. Every board that goes through gets its thickness measured, to fifteen thousandths. The equipment will remember the thickness of every board during the shift and plot it graphically for you. The first column shows thickness sizes. The second column shows the piece count, shown in measurement by inches. The piece count is also presented graphically. You can look at the graph very quickly, figure out how the thickness distribution of boards is coming out of the mill. If the measurement is 1.030, and 1.040 is the target size, then you are going well, if 1.020 is the target size then you are cutting heavy. That is how you start saving fiber. First you have to know what the mill is doing before you can go back and correct or improve it. With this system every board goes through the sorter, every piece gets measured by the thickness shoe, and every piece is plotted on the thickness distribution report.

Many mills have moisture detectors in an attempt to drop out the wet lumber. Unfortunately they do not work well if the lumber is frozen. It would be good to be able to measure the moisture content of frozen lumber. If there were enough sorts the wetter boards could be separated from the drier boards. They could then be dried according to their moisture level. Money would also be saved because boards would not be downgraded by over-drying. Money would be saved in kiln utilization because the less moisture the shorter the drying time.

There is a way to measure moisture in frozen lumber. The volume of a board is known because its length, width and thickness are from the sense zone. We have devised a way of weighing lumber, whether it is frozen or not. Each board is weighed as it goes by the sense zone, the weight of that board is divided by the volume which gives the board density. Density is directly related to moisture.

A plot of some pine lumber run in northeast Washington, shows these densities 31, 32, 33 in pounds per cubic foot. The next column shows the number of pieces that were measured at that specific density during the shift. Again the piece count is plotted for density so there is a graphic representation of the moisture content of all the boards sorted that shift. This particular mill has two break point parameters at about 47 and 75. As each board's density is measured it is compared to the two parameters which define three moisture classes. Each board is then sprayed to mark its moisture. The lumber is then taken out of the sorter and re-sorted by moisture. When it was finished all the heart sap and super sap lumber were separated by moisture and a much better drying job can be done.

We have installed two systems that are weighing lumber and sorting it by moisture. As they have only been in place for three or four months, the only feedback we have received is that the first system has experienced a 17 per cent reduction in downgrade from number 2 common to number 3 common because of over-drying. The benefits have not included the increased kiln production, as the lumber is not dried as long, and the energy savings in getting them through the kiln faster.

The computer cabinet is a 36 inch square box that bolts on the wall of the computer room. One board is the whole computer. There are two more boards which hold the program and data. It communicates with the outside world through cards. There are four power supplies in the box and a fan to keep the circuit boards cool. The rest of it is essentially empty. It is a Nema 12 enclosure and has gasketed doors, designed for an industrial environment. The terminals in use today consist of a CRT screen with keyboard. All the reports come out on a printer. For quick reference of such things as 'production so far' in a shift may be viewed on the screen without printing. At the end of the shift a hard copy report can be made by pushing the print button down in the lower left hand corner.

Many choose a video screen option which displays the bin status of every sort, the number of pieces are counted down to zero as the boards are assigned to each bin. Often the stacker operator also gets one of these, as does the bin chaser, so he can watch the board count down and know which bins are going to be emptying soon, thereby doing a better job at keeping the bins emtpy. Information is also printed on the bottom, such as a description of the last board that went through, the total pieces and the total board foot so far this shift together with the chain speed in lugs per minute. If the foreman wants to know how fast you are running, or how you are doing so far this shift he just walks into the computer room and takes a look at the video. The information is updated every board and the chain speed is updated every second.

There are remote stations that go out on the bin wall. They have the 64 inputs and outputs and are about 24 by 30 inches. There are remote stations with 64 channels of information condensed by this computer card. All that information is sent back to the computer through six of these skinny little wires, eliminating huge bundles of copper going all the way back to the computer room.

What is the cost of a system? The standard dimensional sorter package has three or fewer grades or species, no more than four thickness, seven widths, and 10 lengths and not more than 30 sorts. It probably will not have 255 jay bars nor more than 60 lugs spaces from the lug loader to the jay bar location. Such a package sells for $27,500 American. The addition of 20 more sorts raises the price $5,100. A slash and no trim input for two foor intervals up to eight feet near trim and far trim can be had for an additional $4,700. This is a standard package, there is no money allowed for engineering and no money is charged for programming. We build the hardware, copy the program and mail it to you. Standard packages do not fit many systems and in these cases a custom made system must be designed. Describe any configuration and we can build a system to control it. On a custom system two of the options discussed may be added. The ticket printer includes the printer, the software to keep track of all the loads and print the tickets, and the isolation electronics so mill noise will not confuse the computer. The cost is $10,200.

For smaller systems that do not need the extra memory already built into the package, $1,100 is deducted because one less memory board is needed.

The other option discussed was the weigh scales used for measuring the moisture of frozen lumber. The package includes the rails, the interface from the electronics, the report that plots the density distribution, either sorting by moisture into different bins or spraying boards to mark the different moisture categories. This will cost $30,000.

* * *

FIGURE 1

LUMBER TALLY REPORT

LT1
Lumber Tally Pieces and Board Feet **01/01/00** **01:36:37**

GRADE GRD 1

	8′	10′	12′	14′	16′	18′	20′	Total
1″ x 4″	37	31	25	22	25	21	28	189
	99	103	100	103	133	126	187	851
1″ x 5″	37	39	30	24	22	22	20	194
	123	163	150	140	147	165	167	1055
1″ x 6″	36	32	21	22	28	27	27	193
	144	160	126	154	224	243	270	1321
2″ x 4″	30	26	25	19	21	17	17	155
	160	173	200	177	224	204	227	1365
2″ x 5″	44	46	26	24	32	21	29	222
	293	383	260	280	427	315	483	2441
2″ x 6″	38	25	26	19	25	26	25	184
	304	250	312	266	400	468	500	2500
TOTAL								
PCS.	222	199	153	130	153	134	146	1137
B.F.	1123	1232	1148	1120	1555	1521	1834	9533

GRADE GRD 2

1″ x 4″	25	33	15	21	17	24	20	155
	67	110	60	98	91	144	133	703
1″ x 5″	45	46	27	30	23	30	22	223
	150	192	135	175	153	225	183	1213
1″ x 6″	30	39	21	23	21	27	27	188
	120	195	126	161	168	243	270	1283
2″ x 4″	42	33	20	23	21	22	23	184
	224	220	160	215	224	264	307	1614
2″ x 5″	36	47	24	27	23	22	22	201
	240	392	240	315	307	330	367	2191
2″ x 6″	33	30	24	27	23	32	31	200
	264	300	288	378	368	576	620	2794
TOTAL								
PCS.	211	228	131	151	128	157	145	1151
B.F.	1065	1409	1009	1342	1311	1782	1880	9798

GRAND TOTAL

	8′	10′	12′	14′	16′	18′	20′	TOTAL
PCS.	433	427	284	281	281	29	291	2288
B.F.	2188	2641	2157	2462	2866	3303	3714	19331

SHIFT C

FIGURE 2

PRODUCTION STATISTICS REPORT 11/10/83
14:33:28

Sorter	Pieces	Lineal Feet	Board Feet
	14375	207946	233469

Board Footage Currently In The Sorter	87926
Total Time Into Shift	393
Break Time Taken This Shift	70
Available Runtime	323
Minutes Running	274
Minutes Down	49
Down Time: Percent	15%
Idle Periods	4
Average Idle Period (Minutes)	12
Lugs Run	18632
Lugs Used	14375

FIGURE 3

DIAGNOSTIC REPORT

.DR1

Diagnostic Report 12/02/82 17:44:00

4	(1)	System Restarts
1	(4)	Null Interrupts
3	(20)	No Tallies
180	(21)	No Sorts
3	(22)	Power Fail Rejects
537	(30)	Sense Zone Pieces
1	(47)	MAX Interrupts/Sec
1	(49)	Interrupts/Sec for 1

FIGURE 4

MAINTENANCE AIDS

HARDWARE:

- ON/OFF/AUTO FOR EACH INPUT AND OUTPUT CHANNEL
- LED ON PHOTOCELL

SOFTWARE:

- DIVERTER TEST
- PULSE OUTPUT
- SHAFT ENCODER TIMING
- MONITOR INPUTS AT TERMINAL
- FIRE OUTPUTS FROM TERMINAL
- PROGRAM SELF-CHECKING

FIGURE 5

SAMPLE PACKAGE TICKET

DATE	SHIFT	SPECIES	MOISTURE
11/11/83	DAY NIGHT	CEDAR	GREEN

THICKNESS	WIDTH	SURFACE
2	4	S4S

	GRADE 1	GRADE 2	GRADE 3
6'	XX	XX	XX
7'	XX	XX	XX
8'	XX	XX	XX
10'	XX	XX	XX
TOTALS	YYY	YYY	YYY

TOTAL PIECES: AAAA
TOTAL BOARD FEET: BBBB3

The Mechanical/Electrical Interface

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Electronics in sawmills has now become a daily subject of conversation. It has great advantages, but because of its apparent complexity, seems to frighten the sawmiller who has heard of bad experiences. The electronic technology has developed very rapidly in the last decade, much more rapidly than the mechanical equipment has. As a result, there are a lot of computer controlled packages that are available on the market. They all can do fabulous things but it does not mean that your equipment can do it.

For instance, there is a program called the Real Shape Solution. This program, with the use of two-axis scanners, determines how to saw a log according to its shape and not only according to its average diameter. If such a system is installed in front of a conventional twin band with symmetrical setwork, and push-dog infeed, or conventional chipper canter with vertical belt infeed, or in front of a conventional Mark II Chip-N-Saw canter, it is obvious that the machinery cannot do what it will be told by the computer because these infeeds do not position the log, they just feed it.

In such a case, the mill owner is not getting the recovery he was promised, and will probably be reluctant to recommend the system to somebody else. Actually, it is not the electronic system that is wrong, nor the equipment. It was the idea of trying to have one work in conjunction with the other.

To help clarify some of this type of confusion that exists today, we will underline:

- The needs: What does the sawmiller need to know to inform him adequately on the performance of his mill?
- The electronic equipment: There are various types of electronic products available today and we will try to define them for you.
- The applications: What to buy to meet the needs?

The Needs

What a sawmiller needs to know to adequately evaluate his performance is, from our point of view, as follows:

- The recovery
- The efficiency
- The productivity

The Recovery

I think it is most important for a sawmiller to know accurately how much lumber he is getting for the volume of sawlogs that is introduced in his mill. To obtain this information, and I repeat very accurately, one needs electronic equipment.

The recovery of a mill is represented by the lumber recovery factor or LRF. The LRF of a given production line is the ratio of sawn lumber in FBM, measured after the trimmer over the volume, in cubic feet, of logs that has been introduced in the headrig.

I will add that it is important that the volume be measured at the infeed of the headrig, for it is this volume that will be transformed in lumber. In other words, to determine the LRF one should not use the volume provided by scaling of treelength in the yard, for while slashing a certain amount of fibres are transformed in chips or left as broken pieces. A recovery calculated from the volume of treelength will give an erroneous LRF and does not give an adequate evaluation of the performance, from a recovery point of view, of a given production line.

As an example, a difference in recovery of 0.2 FMB/cubic foot for a line that produces 50 million

board feet a year can represent two million board feet more or less.

We say that, with the equipment now available on the market, a production line today should produce lumber at the rate of seven FBM/cubic foot. I do not know what the average lumber recovery factor for the eastern Canadian mills is. I think it must be somewhere between five and six FBM/cubic foot. There is room for improvement and we will outline the methods of increasing the recovery factor later in this paper.

The second factor a sawmiller must know is the efficiency of his headrig. The efficiency factor is the ratio of the actual headrig throughput in linear feet over the maximum theoretical headrig throughput also in linear feet. It is given in percentage. For example, a headrig running at 300 FPM for seven and a half hours and processing 4000, 16-foot logs is only running at 49 per cent efficiency.

This means that in 7-1/2 hours of production or 450 minutes 50 per cent of the time or 229 minutes there were no logs in the headrig. The machine was consuming power and time and was not producing anything.

The example that we have chosen is quite common: 300 FPM headrig, 4,000 logs a shift.

In our opinion, an efficiency of 50 per cent is most unacceptable. A field such as the lumber industry, which is going through hard times, should set itself higher standards. We are of the opinion that a headrig should run at an efficiency of 75 per cent. Again, it can be done, some do it. The equipment is available and we will come back to it later in the paper.

The Productivity

Determination of the productivity of a sawmill complex is the best way to evaluate the performance of the plant. Then again, it has to be well determined so that one sawmiller can compare his performance with his competitors.

From our point of view, there is only one practical way of determining the productivity factor of a sawmilling complex. It has to incorporate everybody on the payroll and the total output of saleable lumber.

For example, a mill producing 75 million board feet per year of saleable lumber, with 150 men on the payroll, working 240 eight hour shifts per year, has a productivity of 260 FBM/man hour. I wish to be precise here and emphasize that the total number of men must include everybody on the payroll. Treelength handling, slashing, debarking, sawmilling, sorting, drying, planing, chip handling operators, millwrights, filers, electricians, mechanics, foreman and plant superintendent they must all be included. We believe a factor of 260 FBM/man-hour is unacceptable.

In our opinion, the lumber industry in eastern Canada should set itself a standard of 500 FBM/man-hour. Again, it can be done and some are very close to it.

We will now tackle the second part of the paper and discuss the type of electronic equipment available on the market and being currently used in sawmills. There are:

- Microprocessors
- Minicomputers
- Programmable logic controllers

The microprocessor is an integrated circuit which is an electrical component on a printed circuit board. It was originally designed in the 60's to perform the same functions as a computer, but to do so using much less physical space and power. It is directly programmed using assembly language or number code which is of little use to anyone but an electronic engineer.

The microprocessor is the basic building block for many electronic products on the market today. For example:

- The personal home computer such as The Apple II or the TRS-80 or the Commodore.
- The programmable logic controllers or PLC's or PC's such as: The Allen Bradley PLC 2/30 or the Modicon 84.
- Minicomputers such as the Intel, the Hewlett Packard or the Digital PDP11.
- Any custom control system such as the Hemco lumber sorter controller or the Innovec carriage and setwork controller.

All these products are what are called 'microprocessor based' products and, as the user of these products, you should never have to work with, or have access to, the microprocessor itself.

The second type of electronic product used in sawmills is the minicomputer. A minicomputer is a computer that can do much more than a home computer but much less than a large computer such as the IBM 370 system.

Modern minicomputers incorporate in their design what are called 'Bit-Slice Microprocessors' connected in parallel. Hence, the minicomputers can process data faster than the personal home computer. It makes it the ideal proposition for 'Real Time Data Processing' encountered in optimization applications which require a very fast rate of through-put. Real time data processing is the method that is used now in optimization programs.

Years ago, when computers were first applied to sawmills, they were slower than today's minicomputers, so they were programmed to find the required solution by using what were called Look-Up Tables. These Look-Up Tables had a predetermined solution for a predetermined input. In other words, the required solution was not calculated at the time the computer was running its program. For example, if you were scanning logs to determine optimum canter settings, the settings were predetermined for a variety of specific logs. If you then wanted to change your canting requirements, say for a change in market trends, the Look-Up Tables had to be re-written, requiring a change in most of the computer programs and a computer programmer to do it.

Fortunately technology advanced, and today's minicomputers are faster at calculating mathematics. So, in today's minicomputers the required solution is calculated while the program is running. This is called Real-Time Data Processing. Every time the input data is presented, for instance, a log completing its pass under a scanner, a new and unique solution is calculated immediately, for instance, the optimum canter setting. If you then want to change the canting requirements, only a single number or constant in the program need be changed, but not the main program.

The third electronic product available on the market for use in the industry is the programmable logic controller. The PLC is a microprocessor based product which was originally designed to replace relay control panels in the automobile industry. Since car models change style annually, the manufacturer had to plan extended plant shut-down to replace and re-wire relay panels every year, at great expense. With the introduction of the programmable controller, auto manufacturers need only to re-write the program and do not have to change any components, which obviously reduces costs.

The language of the programmable controller is 'relay ladder' schematics, the same as that used in designing relay panels. It is, then, understood by maintenance electricians. This makes the programmable controller suitable for many applications in the industry from simple machinery control to generating reports on production, inventory, etc.

The programmable logic controller is built to run in the industrial environment. It is currently used in pulp and paper mills, coal mines, grain elevators, breweries and is now getting into eastern Canadian sawmills. It is rugged, and it requires very little consideration or maintenance while minicomputers require special humidity, dust and temperature consideration.

As far as replacement parts are concerned, they are available at your local electrical supplies distributor. Parts are standard and are then an off-the-shelf item.

Let me add here that since programmable controllers use the relay ladder language it can be understood by both French and English speaking electricians. Then program modifications can be done in-house, unlike minicomputers where programmers have to be flown in from distant locations at high expenses.

To summarize the second part, we will say that because:

- They are simple
- Easy to understand
- Easy to program
- Easy to trouble shoot, and have parts readily available, you should use programmable controllers in your mill everywhere they have the capacity to do the job. For example, replacing relay panels to control a machine or controlling an automatic lumber sorter.

Where the programmable controller cannot do the job, you should use a minicomputer. Optimization programs are an example:

- To analyze and position logs going into a headrig.
- To analyze and position boards going into an edger.
- To analyze and position boards going into a trimmer.

These programs require a lot of calculations done in very little time and the programmable controller, even though the latest models are very powerful, are too slow to achieve this. You then have to go to minicomputers, which are more sophisticated and use program language that your electrician might not be familiar with.

In order to reduce the necessity for production and maintenance personnel to work directly with the minicomputer, most software companies today will

offer you in their package a minicomputer working in conjunction with a programmable controller.

The minicomputer receives the information from the scanner heads, will rapidly determine the optimum solution, will transmit only the solution parameters to the programmable controller which has the function to control the equipment. When something goes wrong, or if something needs to be changed, the electrician will only have to deal with the programmable controller.

Applications

We will now discuss our third subject in this expos]. To meet today's requirements one has to be efficient and being efficient in a sawmill means running with:

- A recovery of seven FBM/cubic foot
- An efficiency of 75 percent
- A productivity of 500 FBM/man-hour

To achieve these standards of performance a sawmill has to be equipped with electronic systems, obviously, but also with adequate mechanical equipment. Mechanical equipment that can perform with great accuracy, the optimum solution that today's software program can provide.

To increase the recovery factor a sawmiller should look at optimizing:

- The slashing of treelength
- The sawing of logs
- The edging and trimming of boards

The operation of optimizing treelength slashing is expensive and does not apply to all mills. Trees in some regions are so small and have to be processed in such large quantities that it would require several optimizers. The feasibility becomes then questionable.

For mills that have 50 foot long trees such systems are recommended. They come with programs that will slash trees for the highest recovery or for the highest dollar value.

For mills not projecting to install such systems in the near future, we propose to install an automated slasher saw. These systems operate as per the following concept:

- The operator analyzes the tree and decides how he will slash it.
- Say he will make one 16, one 12, two 8's.

He will then feed this information into a programmable controller which will take over and complete the operation. This system has the advantage to give the operator more time to concentrate on the following tree and such systems are currently in operation.

To optimize the sawing of logs, the eastern Canadian lumber industry faced a problem.

The best log feeding systems, such as the double-end dogging system or the Bruzaholm system, are very accurate but unfortunately too slow for our needs. In this part of the country we need systems that can feed up to 15 logs per minute and not only six or seven. In order to alleviate this problem we have worked with potential suppliers at the conceptual design of a log feeding mechanism that could comply with our needs; positive positioning with high throughput.

The result of our joint effort is a feed table 39 feet long which can set vertically and horizontally and has vertical and horizontal scanners mounted on its frame.

The concept is as follows: the operator, by means of the log turner, will position the log, say, with the bow up. Once the log is positioned and leaves the turner, it is firmly held in the infeed between the vertical and horizontal chains and the vertical and horizontal press rolls.

The scanners are mounted 17 feet away from the tail end of the infeed. Therefore, by the time a 16 foot log will trigger the scanners, it can no longer rotate.

Then the log proceeds underneath the scanners which will analyze not only its diameter but also its shape. When the log has completed its pass under the scanners, the leading end of the log is still six feet away from the machine 16.5 plus 16.5 equals 33 feet and the infeed is 39 feet. This length has been added for computer time.

During the time the log will travel this distance, the computer will determine the optimum sawing solution and will inform the programmable controller on where to set the infeed table vertically and horizontally and where to set the sawblades or chipping heads.

Now the log is about to enter the machine and, this is the most important feature of this table, the log is in the same position it was when scanned. The result: "You are sawing what you have scanned".

This is exactly what software companies have been demanding. That the log does not move between the moment it is scanned and the moment it is sawn. This

way, they can come up with elaborate software programs that can provide the real optimum solution. Now with such a table you can think of acquiring the most sophisticated software program that will optimize your recovery at the headrig.

For example, the Real Shape Solution program, which works in real time processing and determines a unique solution for each and every log, taking into account not only the diameter but also the crook, the sweep and the butt swell.

There are numerous software programs available, with different trade names. They should be properly investigated prior to making commitments. This infeed table can be mounted ahead of any type of headrig. For high-production mills it should be mounted ahead of combination three or four head canter and twin band.

For small production mills producing 10 to 15 million FBM per year, we propose to mount the table in front of a twin band working in conjunction with a merry-go-round arrangement. The system has a capacity of 15 logs per minute, which could be too much for small mills.

Then the concept we propose is to process, say, five logs and produce five two face cants, return these five cants to the infeed side of the headrig and process them on the flat side. The infeed is designed to do that. Again the computer would determine the optimum sawing solution for these cants. Then in a third pass, you could use the headrig as a resaw and breakdown the cants in two inch by four inch, two inch by six inch or else with North American or overseas dimensions.

The end result: instead of processing 4,000 logs per shift, you have probably processed 1,400 to 1,500 which could be sufficient for you. But the great advantage is that they have all been well sawn. I should add that with such an arrangement only one operator is required.

Another feature of this table is that if you wish to process a log with the bow up you will put more pressure on the side rolls than on the top rolls, so to hold the log firmly but not straighten it. We all know that straightening a small log is the main disadvantage of some infeed tables.

Controlling this infeed is a typical application for both a minicomputer and a programmable controller.

The scanners will feed data on log diameters, tapers and sweep to the minicomputer, which will determine the optimum sawing solution. Then, the computer will feed the programmable controller with the setting parameters which will in turn set the infeed and the headrig. The operator's control panel is interconnected with the PC so the operator can enter manually in the system any information he feels necessary. Obviously, it is a must to equip this infeed table and the headrig with the most accurate positioners available.

Concerning optimizing of small logs, we have all heard the comment that our logs are so small it's not worth optimizing them. On the contrary, an error in positioning a small log is more costly than it is for a large log. For example if by badly positioning a five inch log, eight feet long, you get only one stud instead of two, you lost 50 per cent of end product. On a large log if you spoil one stud out of seven or eight, you're losing only 10 to 15 per cent. In our point of view, it is more important to properly position our small logs than it is for the west coast mills to position their large logs.

Secondly, mill recovery can be increased by optimizing the edging operation. Edger optimizers have been on the market for a few years and have proven themselves. Because of the high cost of edger optimizers, high speed edgers capable of processing 20 pieces per minute should be considered. This way only one optimizer and one edger will be necessary. The conveying arrangement should then be such that all pieces would come to the edger from the same side, to be scanned and edged according to wane rules and lumber price tables. Again, we are of the opinion that it is more important to optimize narrow lumber than wide lumber. If your operator makes two inch by four inch where the optimizer will give you a two inch by six inch, it means a 50 per cent increase in recovery.

Today's optimizers can measure board thickness, width, length, outline, wane and minicomputers can determine the optimum edging solution in one to two seconds. This allows throughput of up to 20 pieces per minute, which is quite acceptable for most applications.

Again, this is an application for a minicomputer and a programmable controller. The PC directs the information received from the computer to the motor control centers, the infeed table positioners and the chipping head or saw positioners.

For mills using twin bands or twin canters as headrigs, two face cant optimizers are available and they operate under a concept similar to edger optimizer.

However, since optimizers are quite expensive, we feel that headrigs producing three or four face cants should be used. If the software program for the headrig can determine the optimum sawing solution, then why produce two face cants and have to start

optimizing these cants again at the cost of another optimizer.

Finally, recovery can be increased again at the trimming operation.

All pieces coming from the machines are unscrambled and processed one by one under the optimizer scanner heads which again measures the width, the thickness, the length and the wane of the board and transmit the information to a minicomputer which can at the rate of 60 PCS/minute determine the optimum trimming solution for each board.

The drop out gates are mounted after the optimizer on the system under review.

With this concept it is the computer that decides whether a board should:

- Be rejected to the chipper
- Be returned in the mill for remanufacturing
- Proceed to the trimmer.

Trimmers working in conjunction with optimizers must be equipped wih a near-end high speed setting gate. This gate will position itself so the zero saw will trim only the minimum at the near-end which can be anywhere between one inch and 23 inches. If it is required to trim more than 24 inches, the two foot saw would come down.

Trimmer optimizers are available in two versions. One has overhead scanning heads, in which case all boards have to be turned with the wane up. The other has scanning heads underneath and over the lugged chains, in which case the boards can proceed in the position in which they are.

In the November 1983 issue of *Timber Processing* there is an article written by Al McInvale giving estimates of the recovery increase at each machine center if optimizers are used. A double taper infeed with flying log turner and optimizers will increase recovery by 14 per cent. An edger optimizer on a dimension line will given an increase of six per cent, and a trimmer optimizer will also give an increase of six per cent for a total of 26 per cent.

The second type of trimmer optimizer discussed is an application for a minicomputer working in conjunction with a programmable controller. The minicomputer determines the optimum solution and the PC controls the drop-out gates, sets the near-end trimmer gate and controls the movement of the saws. To have a continous read-out of the recovery factor, the trimmer optimizer computer must be interconnected with the headrig optimizer, so to compare their throughput and provide a read-out of the LRF on a digital display.

Increasing Efficiency

As previously stated, today's log infeed systems and headrigs are expensive and should not be operated at 50 per cent efficiency. In order to ensure a 75 per cent efficiency at the headrig we have to consider the following criteria.

- The headrig in the mill should not be at the mercy of the debarking plant. In other words, the headrig should never run out of logs due to extended downtime in the debarking plant or for any other bad operating conditions.
- The back-end of the mill should have more capacity than the headrig, in other words, the headrig should never have to slow down or stop due to flooding of downstream equipment.
- An elaborate preventive maintenance program should see that the downtime on the headrig itself be minimized.
- And finally, an adequate infeed system ahead of the headrig should be considered.

Such a system should incorporate a large infeed deck with a capacity of at least 20 to 30 minutes of production and a reliable singulating device that will ensure continuously the feeding of one log but only one. This is an application for a programmable controller.

An elaborate infeed deck system will obviously incorporate photoelectric controls or the newest videoswitches. These detection devices will evaluate the amount of logs on the deck at various points and will, through the programmable controller, control the motion of the deck chains, the unscrambler and the singulating device.

I wish to add here, that it is better to run a headrig at a slower speed and a higher efficiency than to run at high speed and low efficiency. A slower headrig feed speed is likely to reduce surges and plug-ups behind the headrig which are a major cause of headrig downtime.

Let's get back to our example of a line processing 4000 logs at 50 per cent efficiency. To process 4000 logs in 450 minutes at 75 per cent efficiency, a line has to run only at 195 FPM. This means smaller motors on chipping heads or saw blades, less waving of the saw blades and thus more accurately sawn lumber, less downstream equipment necessary to process surges, less chipper plug-ups, all because of a smaller but more regular flow.

Here is a good example of the application of programmable controllers.

They can measure and report on a continuous basis the efficiency of the headrig. PC's incorporate timers. They can then cumulate the time it takes to process each log through the headrig. By comparing this cumulative time to the time elapsed in the shift, discounting coffee breaks, will provide the efficiency which can be reported on a digital display in various places such as the operator's booth and the superintendent's office.

Another way to increase efficiency is the use of reliable board feeders. There is a board feeder on the market that is controlled by a programmable controller. This feeder is quite elaborate but the manufacturer guarantees it will feed a mixture of one inch boards and two inch material very efficiently.

A board feeder installed ahead of the stacker and working in conjunction with a programmable controller will feed the right amount of pieces required for each course. This will reduce board skewing ahead of the stacker arms and thus, eliminate the frequent short stoppages encountered in that area.

Depending on your shift production, it could be possible to run the stacking operation with only the stickerman. Then, besides increasing efficiency, this would increase productivity.

Increasing Productivity

To increase productivity, we must maximize recovery and efficiency using automated equipment wherever possible such as:

- Automated slasher saw controllers
- Automated headrig infeed deck
- Automatic green lumber sorters
- Automated stackers
- Automatic grade mark detectors
- Automatic board feeders
- Automatic dry lumber sorters
- Automatic unstackers
- Automatic strapping machines

All these systems are typical applications for programmable controllers. Furthermore, coffee breaks and lunch breaks should be scheduled at different times for different areas of the complex, whenever possible, so that the minimum maintenance crew is required.

If you want to increase productivity, do not add machinery; it is likely to increase manpower. Eliminate some or replace it by more modern and automated equipment. Do not increase the feedspeed of the headrig; feed it more efficiently. If you increase the speed it is likely to create heavy surges downstream which will reduce headrig efficiency and thus productivity.

To achieve those industry standards of performance, for some sawmillers who operate older mills, it can mean a large and costly modernization program. These programs, however can be spread over periods of three, four or five years so as to minimize yearly capital investments.

At first we believe that any expansion program should be preceded by an exhaustive study of the existing facilities that should include:

- Analysis of actual performance factors
- Settings of target figures
- Preparation of a master plan detailing the various phases of the expansion
- Detailed estimates of capital dollars required to implement each phase
- Preparation of construction schedules so to implement each phase according to availability of money, payback period and duration of mill shutdown (if at all necessary).

The Canadian Government offers to pay part of the cost of these studies and I believe their programs also offer to pay part of the preparation of detailed engineering drawings required for implementation.

To summarize this paper, I will say:

- That it is most important to know the performance factor of your mill.
- That it is imperative to optimize every log, even if they are small, and every board.
- That a long-term master plan must be prepared prior to commencing expansion so as to make sure that each step is made in the right direction.

* * *

The Use of Microprocessors for Sawmill Management Information

P.F. Wade
Concordia University

I am going to discuss designing an information system for sawmill management.

Sawmills present special problems to the system designer:

- For the average accountant the forest products industry is a nightmare of factors. Cunits are transformed into cords, foot board measure and bone dried tons (or is it cubic meters into metric tons and the metric equivalent of cords and FBM?) There are shrinkage factors, percent trim backs, kerfs and cull.

- Secondly, sawmills are usually located in isolated areas. Often the administrative staff has had little exposure to modern data processing equipment.

Last spring Bev O'Keefe, president of Juniper Lumber Company, requested that Currie, Coopers & Lybrand assist with the installation of a computerized information system. I was asked to act as sub-contractor and was keenly interested in the challenge it presented.

Juniper Lumber Company is a New Brunswick firm. It has the capacity to produce 35 million board feet a year from two mills. It is the only independent sawmiller in New Brunswick with a Crown license. It employs approximately 130 people. The exact figure is difficult to gauge because contractors are employed to do a lot of cutting and slashing.

This project was to consist of several stages. In the first, Juniper planned to computerize the production, inventory and shipping functions. This involved mechanizing the processing of the cutters' tally cards, inter-company wood movements, production reports and orders (Figure 1).

The output documents that would be prepared are invoices, loading tallies, contractor settlements, Crown reports and other reports. The next step was to be the mechanization of financial information such as the general ledger and payroll. Forestry planning was the last stage.

Our task was to record and account for all wood movements and processes, beginning with the stump and continuing until the delivery of dressed lumber and secondary products to customers.

On a project of this type, a feasibility study is normally done first. The feasibility study would examine the requirements and the functional specifications. It would recommend types of equipment and software that would be required in processing and estimate their cost.

In this case, because of the remoteness of the location, it was not economically feasible to plan a system around technical programmers and computer operators. Computer equipment was required which would operate without special air conditioning, allowing Juniper to function even though they had a power dislocation or bump, which normally causes havoc with electronic equipment.

The usual approach to finding an economical solution to computer software design is to try to locate a complete package that is applicable to the specific situation. Juniper's requirements did not fit comfortably into any pre-designed package.

The need for easy-to-use software and robustness suggested micro-computers as opposed to mini-computers. The micro-computer, or home computer, has not to date been used often for a comprehensive management information system. It is used for general ledger, spread sheet calculations or budgeting, but the idea of using a micro-computer to cover the whole gamut of activities of a company is a relatively new concept. However, there are many

advantages to having a micro-computer and the main one is price.

The micro-computer can be programmed not only to diagnose its own hardware problems, but also to advise the user of the solution. This cuts down substantially on repair time. Neither is it necessary to have a programmer on site. It is possible for someone in Montreal, for example, to fix a program and send it by telephone to a computer in Juniper. The programmer does not have to make the trip. For a relatively inexpensive price, micro-computers offer tremendous flexibility. They do not require air conditioning. They are very easy for people to use.

Another important aspect that must be considered is the scope for expansion. Should Juniper Lumber's processing needs grow, there must be a need for growth in the information system. More input terminals, increased file size, or extended areas of application may be necessary. It is also important to consider stability of the computer manufacturer. Will the company still be around? One of the problems with micro-computers is that there are many manufacturers springing up and then dying within a short period of three to four years.

During the feasibility study, it is important to look at both equipment and software. Things are happening so fast in computer development that what was not feasible last month may become feasible this month.

Programming is a very expensive activity. We were fortunate enough to find, shortly after the project started, a system which enabled us to do most of the system's development without doing any programming, even though we were developing a custom system. Fourth generation languages are languages which allow a computer system to be put together without programming. A year ago this was not possible; however, this spring we found such a system and used it. This enabled us to curtail the development efforts in terms of programming by approximately 75 per cent. In addition, this language allows for control and audit features. It provides a 'report writer' whereby Juniper staff can produce their own reports 'on demand' without having programmers on site.

Juniper was advised of the risk factor in operating on the edge of technology. The programming language to be adopted was a development language which only months before did not exist; the micro-computer was to be used as a full management tool, whereas previously it had been used mainly for spread sheet calculations and specialized applications. Juniper management chose to take this risk.

So far they have purchased two IBM XT micro-computers. The two computers will be run in tandem. In other words, there will be complete redundancy. There will be two printers, two processors, and two screens. The files are being created in duplicate in case one of the disk drives goes down. These precautions are being taken to lessen the company's vulnerability to equipment breakdown. In addition, there is a local supplier in Moncton who will repair the equipment or provide 'loaners' with a 48 hour guarantee.

From the user's point of view, the equipment consists of a CRT screen and a typewriter-style keyboard. There is a numeric key pad on the right and special function keys, but this is not a very intimidating prospect to a typist.

Test modules of the system were installed just before the presentation of this paper and the system changeover is planned for the end of February, 1984.

To date the micro-computer has been everything we expected. In only a few days the staff were entering tally cards and product information. A typist, who was hired on a temporary basis, had never worked for the company before and had never seen a computer, entered 500 master file records on her second day. We have succeeded in achieving our objective of having a non-threatening, easy-to-use system.

Figure 2 shows the screen for tally card input for tree length scaling. When the operator is going to enter a tally card, the system displays fields for the pile number, the contractor location ID, and the particular product code whether it is a tree length, spruce, cedar or whatever. There are spaces to put the counts for the different butt diameters for tree length. The computer does all the computation for total cunits or total cubic meters. This information is then saved in computer readable form. Analysis by different inventory locations can be performed. The menu tells the operator how to carry out different operations by hitting the various function keys.

Figures 3a and 3b show input screens for the customer file. This must allow for deliveries of pulpwood and chips as well as dressed lumber. Consequently there is room for a number of factors (see Figure 3b) to cover a variety of measurement procedures (e.g. weight, green or bone dry, apparent cords, etc.). These factors are used to relieve Juniper inventories, set up accounts receivable, and pay the trucker and loader. Finally, there is a block of fields which reflect 'accounts receivable aging'. This shows how many dollars have been outstanding for more than 30 days, etc.

Some of the files presently on the system are: customer files, order file, cash receipts, invoices

received, product files, cutting tally files, volume tables, inventory location master file, contractor history, movement slips, prices to wholesalers, and so forth (Figure 4).

The system has a dot matrix printer with variable type sizes. Juniper decided that the printer did such a nice job that it was not necessary to have invoice forms. A loading tally is prepared by the computer before each load goes out. A contractor settlement report (Figure 5) is prepared for each contractor for each activity such as slashing, trucking, cutting and loading. Computerizing this function saves an immeasurable amount of time. Certainly if one was looking at it from a cost savings point of view, this feature alone would practically justify the system.

It was not Juniper's objective to cut staff. They regarded the new system as an investment. Their primary objective was to free themselves from routine clerical work to be able to devote more time to the productive areas of analysis and planning. The secondary objective was to have access to information which was not available before because of the time required to calculate it. Information can be calculated on trends (e.g. the size of the saw logs, sawmill and planner mill yields, and even yields by particular cutting areas in the bush).

When this system is completely installed, Juniper management will probably be in a better position than management in many large pulp and paper companies who have much larger computer installations, in terms of having access to their data. They will be able to develop 'on demand' reports themselves in a few minutes without having to wait a week or more for the programming department. A big plus is that the clerical staff can treat the new system just like a manual system. There is no strong sense of the computer about this particular installation. It is small and innocuous. It sits on a table and is easy to learn. In two or three days anyone can get used to it. A file can be entered or removed just as easily from the computer disk as a folder from a filing cabinet. Modifications to the records are easily made by moving the cursor and typing. It is faster than taking out an eraser and rubbing out a number on a piece of paper and replacing the sheet in a folder.

Juniper personnel have been most supportive of the new system. They were aware of its introduction before the project started and had the opportunity to participate in the system design.

* * *

FIGURE 1

MICRO COMPUTER SYSTEMS
FOR COMPREHENSIVE
SAWMILL CONTROL

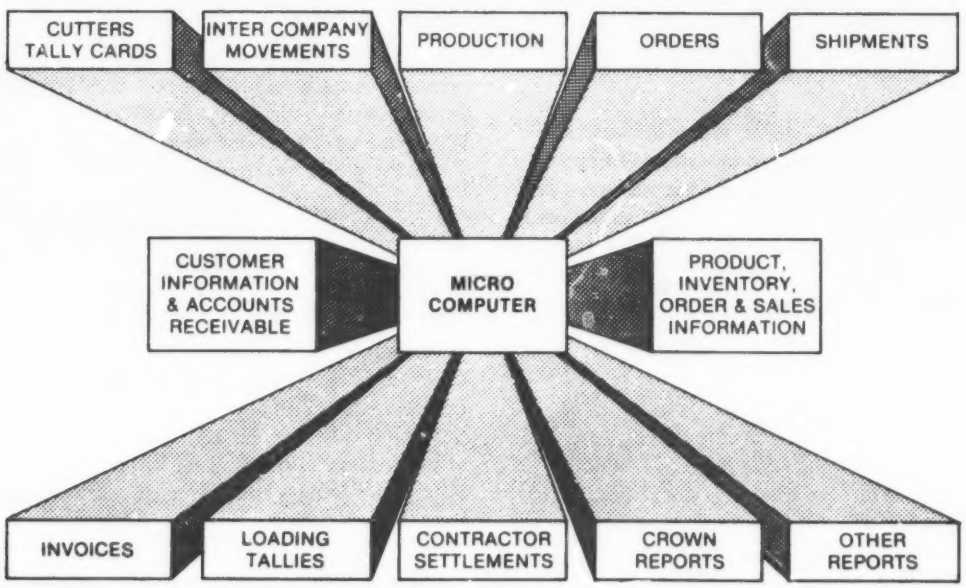

Figure 2

1. Pile Number	2. Cont/Loc.ID	3. Activity Cde
4. Product Code	5. Area ID	6. Block ID
7. Ownership ID	8. Permit No.	9. Contractor ID
10. Skid/Cut Cde	11. 10 CM/C1	12. 12 CM/C2
13. 14 CM/C3	14. 16 CM/C4	15. 18 CM/C5
16. 20 CM Butt	17. 22 CM Butt	18. 24 CM Butt
19. 26 CM Butt	20. 28 CM Butt	21. 30 CM Butt
22. 32 CM Butt	23. 34 CM Butt	24. 36 CM Butt
25. 38 CM Butt	26. 40 CM Butt	27. 42 CM Butt
28. 44 CM Butt	29. 46 CM Butt	30. 48 CM Butt
31. 50 CM Butt	32. Qty	33. Dia (cm)
34. Vol	35. Qty	36. Dia (cm)
37. Vol	38. Qty	39. Dia (cm)
40. Vol	41. Total Pcs	42. Scaler ID
43. Factor	44. Cull	45. Date Scaled
46. Date in Syst		

Figure 3a

1. Cust/Prod ID	11. Type
2. Name	12. Species
3. Address 1	13. Funds Type
4. Address 2	14. PST No.
5. City	15. FST No.
6. Prov/State	16. Discount %
7. Mail Code	17. Discount Day
8. Country	18. Net Day
9. Contact	19. PST Rate
10. Phone Number	20. FST Rate

Figure 3b

Viewing Screen 2 Out of 2 From File: Customer File

1. Vol Units
2. Vol This Mon
3. $ This Mon
4. Vol YTD
5. $ YTD
6. Vol Last Yr
7. $ Last Yr
8. Destn. ID
9. Customer ID
10. Int/Ext Cd
11. Factor 1
12. F1 Units
13. Factor 2
14. F2 Units
15. Factor 3
16. F3 Units
17. Rate
18. Rate Units
19. Bal under 30
20. Bal 30 - 59
21. Bal 60 - 89
22. Bal over 90
23. Total Bal
24. NEW FLD 44
25. NEW FLD 45

Figure 4
Juniper Lumber Company

Director of Files - Lumber

** 1. Customer File
** 2. Order File
** 3. Cash Receipts
** 4. Resequenced Sawlong-FBM Scale
** 5. Invoices Received
** 6. Checks Issued
** 7. Oder Line Items
** 8. Product Files
** 9. Cuttine Tally File
** 10. Volume Tables
** 11. Location Master File
** 12. Contractor History
** 13. Contractors and Suppliers
** 14. Resequenced Product File
** 15. Movement Slips
** 16. Resequenced Movement Slip
** 17. Sawlog - FBM Scale
** 18. Transaction Descriptors
** 19. Production File
** 20. Production History File
** 21. Prices to Wholesalers-Boston
** 22. Operator Security File
** 23. Resequenced Tally Cards
** 24. Contractor History-Cutting
** 25. Resequenced Order Lines
** 26. Tally Cards - Posted
** 27. test & tasks file

Figure 5

Contractor Settlement
Juniper Lumber Co. Ltd.
P.O. Box 120
Juniper, N.B. Canada E0J 1P0

Contractor Name: F
Address: 333
Juniper
Canada

Date: November 8, 1983
Activity: Trucking

Description	Volume	Rate	Amount
8' Hardwood Pulpwood:			
To:			
From:	214.49 Cunits		
To:			
From:	62.58 Cunits		
Total:	277.07 Cunits		
4' Softwood Pulpwood:			
To:			
From:	17.52 M3ST		
Total:	17.52 M3ST		
8' Softwood Pulpwood:			
To:			
From:	19.59 Cords		
To:			
From:	89.44 Cords		
To:			
From:	34.38 Cords		
Total:	143.42 Cords		

The Industrial and Regional Development Program

W.L. Bell
Department of Regional Industrial Expansion, Fredericton

The Industrial and Regional Development Program operates in support of development initiatives according to priorities established by the government. The program is designed to address the needs of business through the typical corporate development cycle with appropriate forms of financial support depending upon the nature of the project, the need for program support, and 'value for money' considerations. Regional considerations are addressed through provision of higher maximum sharing ratios in areas of relative economic disparity by way of new development index and tier group system.

The program is targeted towards two areas which might best be described as commercial or industrial operations, comparable to the types of activity that were eligible under the Regional Development Incentives Program, and non-profit or non-commercial activities, carried out by such groups as municipal corporations, trade and industry associations, universities and community colleges. It is important to note that these latter 'non-commercial' activities must, in fact, be of a nature to support the framework of industrial and commercial operations. Examples of this sort of correlation might be the establishment of industrial infrastructure by a municipal corporation or the initiation of univeristy or community college scholarships or research studies related to business and industry.

In order to differentiate between the two basic types of eligible applicants, i.e. commercial and non-commercial, the act and regulations use the terms 'commercial operation' and 'eligible person'. Thus, while an industrial or tourism project may be sponsored by one of any number of applicants, such as an incorporated company, a partnership, a sole proprietor, or by an individual on behalf of a company to be incorporated, that application would be classified in terms of a commercial operation. On the other hand, a non-commercial venture, supporting industry in some fashion, would likely be sponsored by a municipal corporation, a trade association or a post-secondary school and the applicant would be classified as an eligible person.

The Industrial and Regional Development Program is structured into the following program elements:

- Industrial Development Climate
- Innovation
- Establishment
- Modernization/Expansion
- Marketing
- Restructuring

The maximum level of support under each element is enriched through a graduated scale of four tiers under the tier group system. In reviewing the application of these elements, it is important to note that certain elements apply only to certain applicants.

With these qualifications in mind, we will look at a synopsis of the six program elements (Figure 1). For this purpose, we will ignore the column headed Tier I. The 15 New Brunswick counties fall into one of three tiers: II, III and IV.

Note that the industrial development climate does not apply to commercial operations, that is, manufacturing or tourism projects. The intent here is to enhance opportunities for commercial operations by creating an industrial climate through the efforts of provincial and municipal authorities, academic institutions, industry and trade associations, and the like. Under this element, which has neither minimum project requirements nor a stated maximum level of assistance, we can fund studies relating to economic development, assist in the establishment of non-profit

centres or institutions, and participate in the provision or enhancement of industrial infrastructure in cooperation with provincial or municipal authorities.

The innovation element, the one element with universal application, is fairly straightforward, as shown. However, it is important to note that this element is extremely generous in terms of potential maximums, and also that it is not subject to the mimimum project sizes applicable to some of the other elements. In effect, only the practical aspects in terms of nominal or minimal cost studies or projects would come into play in assessing need for IRDP assistance.

The establishment element can be likened to the new facility incentives that have been available under the Regional Development Program. Insofar as studies are concerned, no formal minimum cost applies. In the case of actual capital projects, Tier II projects would have to be at least $100,000 in eligible costs, Tier II, at least $50,000 and Tier IV at least $25,000. These same minimums apply also to modernization/expansion projects, other than first-time application of microelectronics on which there is no stipulated minimum. I understand that the question of these minimums is under review, and I would expect that the minimums for Tiers II, III and IV may be reduced considerably.

The marketing element, applicable only to non-commercial activities and tourism projects, is intended to assist industry and trade associations, non-profit organizations and municipal corporations, as well as tourist operators, in disseminating and attractively packaging information designed to better market the goods and services of New Brunswick enterprise. Again, non minimum project size is stipulated.

The restructuring element encompasses most of the activities formerly administered under the enterprise development program, other than the innovation portion, which now falls within the IRDP innovation element. It should be noted however, that a policy decision has been made to the effect that the department will refer any enquiries on loan guarantees below $50,000 to FBDB for their consideration.

Insofar as payment of contributions is concerned, the mode and timing of payment varies depending upon the program element involved. With respect to capital costs involved in the establishment, modernization or expansion of a commercial operation, the project must be in commercial production prior to any payment. The initial payment can be up to 90 per cent of the eligible cost incurred to that point. Interim payments can be made during the two-year control period. No payment will be made until the stipulated equity is in place. There is provision for up to 25 per cent overrun on capital costs.

Payments of contributions other than capital costs for establishment, modernization or expansion, i.e. consulting studies, infrastructure, innovation or maketing activities, can be made on a progress basis no more frequent than every three months. Claims for such payments must be supported by evidence of expenditures made.

There is provision for statistical monitoring of the various projects subsequent to expiration of the control period. We would anticipate that this will be onerous.

* * *

Figure 1

Program Elements	Eligible Projects/Activities	Maximum Level of Assistance Tier I	Tier II	Tier III	Tier IV
Industrial Development Climate	Economic Development Studies; Establishment of non-profit centres or Institutions	eligible	eligible	eligible	eligible
	Industry Infrastructure	not eligible	eligible	eligible	eligible
Innovation	Consultant Studies on Technology Transfer, Project Feasibility, Market Research, Venture Capital Search	50%	60¢	75%	75%
	Development of New Product / Processes	50%	60%	75%	75%
	Development of Technology Capability	50%	60%	75%	75%
	Design, Development, Demonstration, Engineering	50%	60%	75%	75%
Establishment	Consultant Studies on Projected Feasibility, Market Research, Venture Capital Search	50%	60%	75%	75%
	Buildings, Machinery, Equipment, Related Infrastructure	not eligible	35%	50%	60%
Modernization / Expansion	Consultant Studies on Projected Feasibility, Market Research, Venture Capital Search	50%	60%	75%	75%
	Modernization: Machinery and Equipment	25%	35%	50%	50%
	Expansion: Buildings, Machinery and Equipment	25%	35%	50%	50%
	Adaptation of Microelectronic Technology	50%	60%	75%	75%
Marketing	Consultant Studies: Collection / Dissemination	50%	60%	75%	75%
	Non-profit Organizations for Market Research and events to promote Canadian Products	eligible	eligible	eligible	eligible
Restructuring	Consultants Studies on Project Feasibility, Market Research, Venture, Capital Search	50%	60%	75%	75%
	Restructuring (Loan Guarantees)	eligible	eligible	eligible	eligible
	Restructuring (Repayable)	25%	25%	25%	25%
	Participation Loans	not eligible	eligible	eligible	eligible

Panel Discussion

John Potter
Kingston Lumber & Building Supplies

Thank you very much. I was delighted to be asked to come here today and say a few words. Before I add a few thoughts I will yield to Mr. Butler, one of my alumni, who is probably much wiser and has that much more experience. I will let him speak first then I will follow up and hopefully get some discussion from the floor.

W.S. Butler
Dead River Ltd.

As an operator of small sawmills, we have become accustomed to regarding electronic technology as a space age concept confined to satellites and Japanese car manufacture.

However, the whole business of microelectronics has become so competitive with the development of the chip that the hardware involved is now relatively inexpensive compared to the rest of the hardware and other factors we have to cope with in managing a plant.

Present economic conditions provide a powerful motor to drive us to consider anything that will make us more efficient and competitive. Since we can't do much about the terrible market conditions, our major thrust has been to reduce costs wherever possible in order to survive in the marketplace. In addition to tough market conditions, we face poorer log quality, increased power, labor and parts costs, as well as a whole harness of government imposed disincentives to business such as increased sales taxes, marketing boards and other factors.

Our goal then is to improve yield from poorer logs and produce a more competitive product at a lower cost and this sounds like mission impossible!

The only approach is to examine each facet of our problem and come up with a solution. We have made some moves in the past to upgrade and we are presently in the process of studying our mills to help us with our short and long term plans for improving mill efficiency, productivity, and profitability.

In a logical sequence of events, your sawmill operation starts in the bush at the stump. What you have to work with will determine your manufacturing strategy. Once you have made your decision as to the best business strategy, you have to structure your whole organization to maximize your advantages and minimize your disadvantages.

Some major problems we have are as follows:

- Yield: With manually operated evaluation of logs it is difficult to train, motivate and maintain a situtation where you get the most out of each log every time. Cheap, fast, accurate, consistent and dependable means of evaluating the best opening face of each log is desperately needed.

- Labor: Sawing costs should be able to be more automated if we can sort out process control. Many of the operations in the mills are repetitive and should be a prime target for analysis. Some mills are already doing things like volume tallies with electronics.

- Management information systems: You never could run any business or organization efficiently without some means of evaluating what you are doing. Most small sawmills do it by guess or by God sometimes with disasterous results. It looks as if microelectronics will be able to provide ongoing analysis of small business in a language understandable to the people in the business at a price they can live with. The answers to daily problems such as inventory analysis, cause of downtime, proper process machinery, production

snags, highlighting of maintenance situations, are areas of prime importance. Timely financial analysis may even become available to the small operator at a cost he can afford.

- Power costs: Is there anything we can do with programmed electric power savings? There must be a better way to reduce power costs. Some of us have installed capacitors in all of our mills. In my view, they are a help but are a very blunt instrument in a situation demanding much attention.

- Inventory control: What can be done to answer the following questions on a basis timely enough to make management decisions?

  - What do I have to sell?

  - Am I producing the right range of dimensions?

  - Do I have a build up of logs?

  - Am I being realistic about the value of my inventory?

  - What is the age of each category, i.e. put "best before" tags on each item.

  - Historical data, i.e. what are my best items as shown by past sales?

  - What must I do to enhance my sales profit margin and volume?

Understandably, most of the attention to this problem in our business has been directed toward large plants.

We have some 130 small sawmills in New Brunswick. Most are owned and operated by hard working ingeneous people who have survived some very tough situations. They are also very leery of fancy gadgets. We all have one thing in common: we've had a very tough three years and we're all trying to survive. We all need help and this microelectronics business looks as if it has great potential.

John Potter

While there is little doubt of the applicability of microelectronics in medium and large corporations, it is our task in the panel to determine what, if any, benefits can be achieved for the small sawmill.

I want to define the small sawmill as one having an annual production of between two million and 10 million board feet on a one shift basis. In Nova Scotia approximately 25 sawmills fall within this category. I would anticipate similar figures in New Brunswick. These mill are typically family owned operations. Located in rural or small urban areas, they make a significant contribution to the areas and communities. In general, these mills vary in age. Often it is easier to build a new mill as Mr. Erskine did in Muskedovit. Some may be two years old, some may be 15. They are there and they are what we have to work with at the present time. In general, they consist of a debarker, either a rosser or ring type debarker, an automatic carriage with, in most cases, a circular headrig and in a fewer cases a band headrig. They have a combination edger and a double end trimmer. That describes a typical mill. There is a green chain and normally a home built sorter of some type. In a number of these mills you will also find resaw of some type or a gang saw for secondary breakdown. Generally speaking, those are the types of equipment that we have in our mills at the present time.

Now that we have this profile of a small sawmill, we are in a better position to discover the role that microelectronics can play in improving productivity.

It may be useful to begin at the head of the mill and follow the sawing process through the facility and quiz the panelists or anyone else who would care to comment on the applicability of microelectronics at any given stage. I am approaching this from the premise that many mills have little or no microelectronic controls. The other factor that must be taken into account in the case of the Maritimes is a log supply of about five million board feet per year made up of a small percentage of large hemlock, a larger percentage of large white pine and various sizes of spruce. It is difficult to saw this mixture of logs on anything other than a carriage. If all the logs were small, they could be sawn on a straight spaghetti machine.

Some of the questions that I would like to ask are probably in the area of log sorting prior to the debarker. In Nova Scotia I do not know of any mills that make a concerted effort to take their log inventory in the yard and pre-sort it before entering it into the mill. This is certainly one area where some type of log sorting facility could be installed. In the final analysis it comes down to cost. How much can we afford to spend on a mill that has an annual production of five million board feet? Are any of these processes applicable to our industry as it stands today?

Next is the log scanning process, which poses a more difficult problem with a carriage than with the other type of machinery that was referred to in most cases at this seminar. The capabilities certainly exist to develop a log scanning and control but is it feasible in our mills to get a higher yield? I was fortunate enough to be able to go to Sweden and Austria with Mr. Erskine when he was trying to finalize his

machinery. One thing I was most intrigued with was the edger optimizer. It was fascinating to watch and try to second guess it. It was so quick. This was a larger mill but it still worked. It would react quickly, make the decision, and put the board through right time after time and never complain. That is perhaps one area where there is a possibility of devising something compatible for us.

I would like to ask our panelists and anyone else in the audience if they have any views, ideas, or initial reaction. Give us some idea of whether some of the great and wonderful things we heard today can be applicable to our operations. I will begin by asking Jacques S]guin for his views on whether he feels there are any areas within the sawing operation I described where we can apply microelectronics.

Jacques Seguin
J. Seguin Consultants Inc.

The type of infeed I have been talking about with optimizing scanners and computers can increase recovery between 10 and 15 per cent. For a mill producing eight million board feet, it will mean 1.2 million board feet. How much money does 1.2 million board feet represent to you? If it is an increase in recovery, you have not consumed more fiber, you have used the same amount of wood but produced 1.2 million board feet more.

John Potter

That is the type of answer that we can appreciate in terms of what our volume is today and what log supply we are restricted to. Certainly if that kind of saving is achievable in a mill that produces four to eight million board feet these days, there can be a fair amount of money spent to do something, either by changing the type of headrig or possibly adding these scanners to the carriage. Is it possible, with varied log size quality, to apply a scanner or optimizer in part or in whole to a log carriage system with a circular or band headrig in a mill of that size? Or does it have to be in relation to a different feed system either a twin band, chip and canter or a quad type of operation?

Howard Borer
North American Controls Inc.

Sorting is really my expertise, but I am aware of the existence of several carriage setwork systems that we have with scanning heads above and below. As the log is presented onto the carriage it passes through the light beams which scan the diameter and determine the sawing solution for the carriage. The systems exist. We have them installed. I cannot speak for the volume produced by the mill to decide where the cost effective break-off is, but the systems do exist.

B. McCollough
provincial government

In the case just mentioned, is the log scanned before it goes on the carriage?

Jacques Seguin

I think that you should scan the log when it is on the carriage after it has stopped moving. A tree or log should be scanned when it is stationary and should be processed when in the same position. Put the log on the bunks of the carriage, scan it and then decide what to do with it.

John Potter

There are some systems that are linked directly to the sawyer and others, as indicated by Mr. Gorman, where it is an assist program that shows a picture of how the log should be sawed according to the diameter. I guess these are things that we are going to have to come to grips with. Either we all have to build a new mill and saw one size of logs, or we have to try to adapt this type of technology to what we have, based on equipment now as well as our log supply. In many cases a limiting factor is a log supply.

Jacques Seguin

What size of log are you talking about?

John Potter

Our log size varies from five inch top up to a 40 inch top. We have first growth hemlock which we are sawing right now. We have a 26 inch Cambio debarker. It is not a very big run of hemlock in terms of volume but out of our production we would do 300,000 or 400,000 feet per year. These logs fill out our time and therefore we have to saw them. Nearly 10 or 15 per cent of the hemlock we get will not fit through our debarker which is another problem.

The normal diet is spruce, with an average of five to 17 or 18 inch top with more down at the lower end than at the upper end. To some of this the microelectronic systems are certainly applicable, especially to our management systems, as indicated by Mr. Wade, with micro-computers. We have taken the first step in that direction. For the past two years we have had all our systems done through a service bureau instead of taking the risk of buying the software and hardware. We now know what types of reports we want. The next step, which we plan to take fairly soon, is to go to micro-computers. For those of you who are leery of such systems, I would comment that after having had it for two years and getting these reports, if someone told me that I would not be getting them for a month I would probably not sleep too well

for a while. One gets used to this type of information very quickly. I assure you that once you have a system in place and you are over the initial fear it is most helpful.

They have an edger optimizer at Hugh Erskine's mill. I would just like an idea of what the cost of that type of edger system might be.

Jacques Seguin

Between $300,000 and $500,000.

John Potter

That exemplifies the kind of problem we are running into, although the new systems are not so expensive.

Jacques Seguin

There are different versions of edger optimizers. The full-blown system that I am referring to costs between $300,000 and $500,000, which includes the mechanical hardware, the infeed that will position, the computer and the programs. There are companies that offer systems that are partly automated. The operator might have to touch the board occasionally but these systems do cost less; however, I am not familiar with them.

John Potter

Mr. Erskine's mill is much the same as Jacques Seguin mentioned. It takes the log around. It does not only go through, it can bring it back around and use the twin band as a secondary or tertiary breakdown, as well as his headrig.

Jacques Seguin

The merry-go-round arrangement. It is typical of sawmills in this area. In a small mill it is not necessary to process 15 logs a minute, five would be sufficient, so you use the same machine and the same infeed. Thus, the same electronic system that does the primary breakdown can do the secondary. Preliminary steps have been taken with potential suppliers to develop a compatible infeed. We should tak to a potential supplier, such as North American Control, to develop a system that does not need to be as full-blown as if you were producing 100 million board feet. Instead of custom built it should be a standard package with additional software at additional prices. If a potential supplier of software programs and optimizing systems would be interested in working to develop such a thing, there could be a good potential for him to sell many of them at a good price.

D. Sproule

I would like to ask Jacques if he has any ball park figures for a scanner on the infeed logging and outfeed tallying of the lumber?

Jacques Seguin

It should be $30,000.

* * *

Closing Remarks

R.W. Stephens
Director of Research, Forintek Canada Corp., Ottawa

This brings us to the end of the seminar. I want to add my sincere thanks to everyone for their interest, attention and their profound patience. On behalf of Forintek Canada Corp. I wish to thank the federal Department of Regional Industrial Expansion for providing us with this opportunity. I also wish to express our sincere thanks to the executive and staff of the Maritime Lumber Bureau, in particular the New Brunswick Forest Products Association and Nova Scotia Forest Products Association, for all their support and co-operation toward making this happen.

The translators have been most helpful and we convey our thanks for a very valuable service. Last, but by no means least, I wish to thank, on behalf of Forintek, all of the speakers who have participated today. Some have travelled tremendous distances to be here. They have all given unstintingly of their time, experience and knowledge. Despite some of the reservations some of you may have at the present time, I am sure you will be hearing more from them.

It has been a great pleasure for me to work with such a professional group and I want to thank them all.

* * *

Forintek Canada Corp.

Canada's National Wood Products Research Institute

Established in 1979 as a private, non-profit corporation. Forintek is funded from contract research work, industry support, and government grants and contributions. The staff of 200 is about equally divided between its Western Laboratory in Vancouver and its Eastern Laboratory in Ottawa. The corporate office is located at Vancouver, at the Western Laboratory.

A key element in the operation of Forintek is industry involvement in its research programs. This is accomplished through Research Program Committees and a Board of Directors which consist largely of senior representatives from industry, as well as representatives from federal and provincial governments. It is through these forums that a means is established for industry to have strong input into Forintek's operation, program planning and assessment.

By responding to industry's research needs directly, Forintek plays a vital role in solving technical problems and helping the Canadian wood products industry maintain its competitive position in world markets.

"Productivity improvement" is a common objective for industry and government alike. Accordingly, the federal Department of Industry, Trade and Commerce and Regional Economic Expansion is financing a series of seminars addressing productivity improvement through electronic-based technology. Forintek Canada Corp. will be presenting these seminars on behalf of the federal government during 1983 and 1984.

Enquiries relating to Forintek's services and seminars may be directed to:

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